Advances in Intelligent Systems and Computing 498

Jussi Ilari Kantola
Tibor Barath
Salman Nazir
Terence Andre *Editors*

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Janusz Kacprzyk, Polish Academy of Sciences, Warsaw, Poland
e-mail: kacprzyk@ibspan.waw.pl

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Editors
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University of Vaasa
Vaasa
Finland

Tibor Barath
Hungarian-Netherlands School of Educational Management
University of Szeged
Szeged
Hungary

Salman Nazir
Faculty of Technology and Maritime Science
University College of Southeast Norway
Kongsberg
Norway

Terence Andre
TiER1 Performance Solutions
Colorado Springs, CO
USA

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Preface

This book provides researchers and practitioners a forum to share research and best practices in the application of human factors to training, education, and learning sciences. Just as human factors have been applied to hardware, software, and the built environment, there is now a growing interest in the optimal design of training, education, and learning experiences. Principles of behavioral and cognitive science are extremely relevant to the design of instructional content and the effective application of technology to deliver the appropriate learning experience. These principles and best practices are important in corporate, higher education, and military training environments.

The book aims to share and transfer not just knowledge, but also leadership and management science that is of real value in practical terms; value that can help leaders ensure their organizations stay ahead of the competition through continued innovation, strong competitive advantage, and inspired leadership.

A total of 21 sections are presented in this book. Each section contains research paper that has been reviewed by members of the international editorial board. Our sincere thanks and appreciation to the following board members:

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Part I
Competency-Based Education and Personalized Learning

The Impact of Competency-Based Learning and Digital Self-assessment on Facilitating Students' Cognitive and Interpersonal Skills

Yashu Kauffman and Douglas Kauffman

Abstract This paper aims to utilize a mixed-methods assessment for an innovative interdisciplinary course, Application Period, in a world-class Russian University. In order to examine how the cognitive (competency-based learning) and motivational (self-efficacy for interpersonal skills) concepts impact students' achievement in engineering education, an exploratory sequential design was conducted by firstly collecting qualitative data to signify the students' interactive learning process during the project-based collaboration and team communication. Subsequently, two instruments measuring the students' learning outcomes were built based on the previous qualitative data and preliminary learning objectives. The suggestions and implications are provided to specify how to employ competency-based learning and self-efficacy for interpersonal skills in teaching and how to assess those content knowledge and pedagogical skills in contemporary education.

Keywords Competency-based learning · Self-efficacy · Assessment · Mixed-methods

1 Introduction

Cognitive science in the sense of how individuals effectively acquire, construct, and transfer knowledge is a significant line of learning in science, technology, engineering, and mathematics (STEM) education. Specifically, scientists and educational researchers have actively engaged in exploring how innovative teaching-learning strategies and pedagogies facilitate students' academic achievement and how per-

Y. Kauffman (✉)
Massachusetts Institute of Technology, Cambridge, MA, USA
e-mail: yashu@mit.edu

D. Kauffman
Boston University, Boston, MA, USA
e-mail: douglas.kauffman@bmc.org

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formance assessments would accurately measure students' learning outcomes and provide reliable interpretations of students' learning effectiveness and efficiency [1].

Numbers of studies have specified that today's students, whether they be engineering, science, medical, or education, must acquire not only technical knowledge but also a broad body of disciplinary knowledge specific to their field [2]. The Accreditation Council for Graduate Medical Education (ACGME) and The American Board of Surgery for example, have recently instituted the Milestones Project for General Surgery Residency (ABS) training. ACGME and ABS have identified approximately 70 *milestones* that they believe reflect what surgeon's must be able to do effectively. Surgical residents must demonstrate they are meeting these milestones throughout their 5–7 years of training. These milestones fall within 6 competencies including, patient care, medical knowledge, practice-based learning and improvement, systems-based practice, professionalism, and interpersonal and communication skills. In other words, besides gaining technical skills and disciplinary knowledge, we now recognize that students—both engineering and surgery—should learn how to construct, process, and apply fundamental knowledge by using cognitive strategies, analytical reasoning and problem-solving skills in authentic learning environments. Furthermore, they need a wide array of learning opportunities to practice personal and interpersonal skills that will allow them to function effectively and efficiently in real engineering teams and to create innovative impact to ecosystem.

Therefore, we began by asking to what extent can instructors make teaching and learning more effective for engineering related courses? It is undoubtedly that intrinsically motivating students (e.g., increase students' curiosity or interests) to engage in high level of cognitive learning (e.g., problem-solving skills) through authentic environments is significant in effective teaching and learning settings [3, 4]. However, how do instructors practically design and deliver engineering courses to motivate and facilitate students to actively and intrinsically engage in cognitive learning? Particularly, the questions most educators and researchers wonder in engineering education have being focused on how to embody the pedagogy of authentic learning and active learning into content knowledge teaching (e.g., the lectures including heavy abstract mathematical concepts, such as quantum physics) and interpersonal skill learning (e.g., teamwork and communication) to optimize teaching-learning effectiveness. Thus, the purpose of this study is to investigate how the cognitive (i.e., authentic learning) and motivational (i.e., self-efficacy) strategies impact interdisciplinary learning in engineering education.

2 Perspectives

Based on cognitive learning theories, in order to effectively comprehend, build, retrieve, and apply learned knowledge and skills, we believe students should engage in active rather than passive learning by participating in collaborative activities and by thinking about and elaborating on their communication practices. In short, authentic

learning is important because it helps learners to connect the new information with their prior knowledge by constructing and representing the integrated ideas during collaboration and communication with others who are also experiencing real-world problems. The learning process of identifying new concepts, selecting appropriate strategies, and analyzing the consequences for authentic problems is the key element of scientific approach for successful learning achievement.

Furthermore, among several motivational factors, personal causality operates as a cognitive dynamic phase based on motivation, emotional activation, and, schematic processing of decision-making [3, 5]. The quality of effort in terms of individual engagement toward accomplishing tasks has been strongly linked to self-efficacy [3]. For that reason, it is difficult for an individual to achieve successfully when they doubt their ability. Briefly, successful performance is thus determined by an individual's judgment of his/her ability within a subject and the belief that individual has that he/she can accomplish a specified task given that skill level. Then, based on the positive mastery experience, the judgments of learners' self-efficacy would impact their choices of activities and level of engagement. That is to say, in a teaching-learning setting, the lack of self-efficacy may result in learners' negative attitudes and low achievement.

As a result, with the need of contemporary disciplinary knowledge and skills in engineering education, teachers must begin to help students achieve intended learning outcomes and meet enterprise and societal needs by applying the fundamental knowledge and skills to solve real-world problems and increase their self-efficacy for certain domain knowledge. However, how do educators construct meaningful intended learning outcomes and embed active learning into the curriculum to increase the students' learning achievement in an effective pedagogical method? Furthermore, which validated methods of assessment can accurately evaluate students' actual learning outcomes and reflections in engineering education? Accordingly, there is an increasing need for educators and researchers to explore how to measure if students efficiently gain technical knowledge and skills and effectively utilize personal and interpersonal skills to function in real scientific teams and produce innovative products and systems.

2.1 Building the Innovative Interdisciplinary Studies

In order to foster engineering students in transferring knowledge and applying learned skills in authentic situations, a 1-week *Application Period* interdisciplinary course was designed, developed, and implemented to focus on innovative activities in a Russian University located in Moscow. This new private graduate university was founded in collaboration with Massachusetts Institute of Technology (MIT), which co-designed and co-implemented the curriculum and courses in the fields of energy, space, nuclear, biomedical engineering, and product design and manufacturing. The aims and pedagogies of the university curriculum are to address critical

scientific, technological, and research-based knowledge to foster innovation in education and research.

The infrastructure of each academic semester is a 6-1-1-curriculum (8 weeks) design for a full term. The standard 8-week term includes an instructional period with teaching and learning activities for 6 weeks, a 1-week summative assessment, and a 1-week Application Period at the end of each term. Specifically, all formal instruction will be completed before the Friday of week six for each term. During weeks 1–6, the teaching and learning activities are focused on engaging students in gaining fundamental disciplinary knowledge in science, technology, mathematics, and engineering. The summative assessment that takes place during week 7 is designed to let students demonstrate and reflect on what they have learned by completing a series of formative assessments. Each course has its summative assessment, and the course instructor is responsible for designing and developing the assessment that can be written, oral, hands-on, or a suitable combination of learning achievement evaluation.

The week 8 Application Period is designed to provide students with interdisciplinary studies and authentic learning experiences. It provides students opportunities to combine two or more disciplines into one final project and to engage in hands-on activities that reflect real-world problem solving. The final project requires students to apply the fundamental engineering content knowledge they have learned from the previous 6-week instructional term. It also includes multiple opportunities for students to apply theme-based interpersonal skills (e.g., communication) based on the university Learning Outcomes Framework.

2.2 *The Learning Outcomes Framework for Application Period*

The CDIO syllabus [6] pedagogy, which stands for conceiving, designing, implementing, and operating, has played a key role and framework for the design of intended learning outcomes of the *Application Period* course. Much like the General Surgery Milestones project, the CDIO framework is designed to set curriculum benchmarks and also to capture the needs of engineering researchers, students, educators, and stakeholders to integrate innovation, research, and education in a pioneering international university for bringing about entrepreneurial impact in society. For example, the Learning Outcomes Framework [7] of the Russian university was developed and customized in four sections of educational learning outcomes: (1) disciplinary knowledge and reasoning, (2) personal attributes—thinking, beliefs, and values, (3) relating to others—communication and collaboration, and (4) leading the innovation process.

In addition to the hands-on and innovation capability, students are required to develop and apply personal and interpersonal skills in Application Period. According to the university Learning Outcome Framework, the personal skills

Table 1 Themes of personal and interpersonal skills for each application period

Terms	Students	Themes (based on the learning outcomes framework)
Fall Term 1	1st year	3.1 Communications—oral presentation and discussion
	2nd year	3.1 Communications—written, electronic and graphical communication
Fall Term 2	1st year	3.3 Teamwork
	2nd year	3.4 Collaboration and change
Spring Term 3	1st year	2.1 Cognition and modes of reasoning
	2nd year	2.3 Ethics, equity and other responsibilities
Spring Term 4	1st year	2.2 Attitudes and learning
	2nd year	3.2 Communications in international environments

include cognition, modes of reasoning, attitudes and learning, ethics, and equity. The interpersonal emphasis includes communication, collaboration, and teamwork skills. Each Application Period is focused on different themes from the personal and interpersonal learning outcomes (see Table 1) and a facilitator would co-teach the learning activities for the special theme for each term. For example, the theme of first Application Period was "communication (oral presentation and discussion)". Therefore, besides the hands-on project, students had the extra learning activities and direct feedback and interaction with the facilitator advising effective communication skills.

3 Methodology

Due to the innovative design and integrated learning outcomes of Application Periods, it is imperative for engineering educators and researchers to understand the notion of "what works" and also to be able to select the strategies that "work the best" for emphasizing the instructional values, curriculum goals, logistical constraints, and student expectations. That is to say, one data source alone is insufficient to explain the interrelated components of the design and implementation of the Application Period. Additionally, in order to be responsive to new insights of an innovative engineering application, a rich assessment based on solid theoretical standpoint needs to combine participants' and researchers' perspectives through revealing meaning by qualitative approach and uncovering relationships between variables by quantitative instrument and analysis [8]. For that reason, a mixed methods research design should play the role effectively.

3.1 A Mixed Methods Design

This mix-methods assessment is an exploratory sequential design. The sequential design began with collecting qualitative data including observation notes, pictures, and videos of group discussion during the hands-on activities to represent the learning process of students' teamwork and communication Subsequently, a quantitative data collection including two instruments was built based on the previous qualitative data and the intended learning outcomes (Fig. 1 shows an example).

3.2 Participants and Procedures

Fifty-seven graduate students participated in the first two Application Periods (i.e., App 1 and App 2) to engage in hands-on learning activities with domain experts. The teaching and learning activities included instructional lectures for design and communication, group brainstorm sessions, team collaborations and presentations, and hands-on projects. The data collection began with writing the observation notes that were based on the daily learning topics and activities, instructors' interactions with the students (questions and responses), students' specific learning behaviors, learning materials and environments. The observation notes include a rubric system to measure students' interactions with the instructors and peers based on the "personal and interpersonal" Learning Outcome Framework. Each category was scaled from ineffective (1), developing (2), accomplished (3), and exemplary (4) based on the level of interactions between the instructor(s) and the students during the teaching and learning activities. Additionally, multimedia data (e.g., pictures and videos) were also collected.

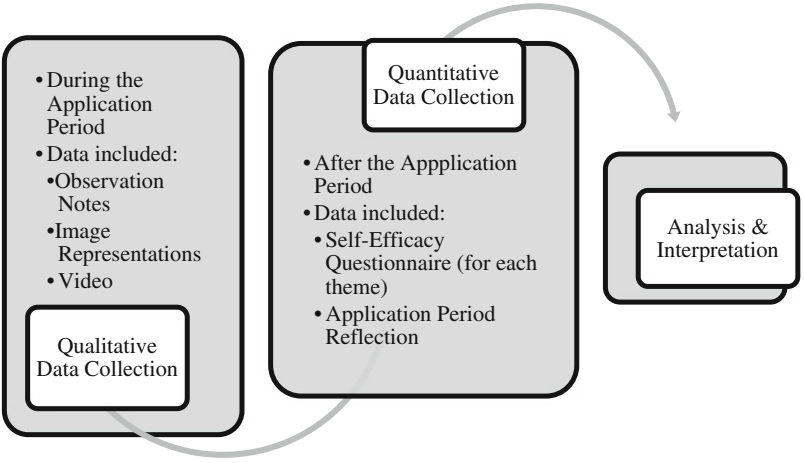


Fig. 1 The exploratory sequential design

Based on the exploratory qualitative results, a quantitative phase was designed and conducted to generalize the initial findings. Specifically, after the qualitative stories and data about the students' learning experiences and interactions with the instructors and peers to identify the conditions, consequences, and the learning outcomes, the categories were emerged from the qualitative data as variables. Thus, the quantitative instruments were developed and used to assess the self-efficacy for the specific theme of each term and the overall learning outcomes of the Application Periods.

4 Results

4.1 Qualitative Data

The qualitative data including collecting observation notes, images, video clips, and informal interview with the instructors and the students were analyzed and coded based on the Grounded Theory. Based on the analysis and coding method, several themes were emerged from the Application Periods (Fig. 2 shows the themes).

4.2 Self-efficacy Questionnaires

Application Period One—Oral Communication. The tasks as described include both formal communications, such as defining the speaker's objectives, the audience's expectations, and informal communications. In general, student confidence



Fig. 2 Word cloud of the emerged themes from application period

in their communications skills increased substantially over the eight days of the Application Period. The smallest change was a 7.0 % increase in the ability to identify speaking objectives, which was not a statistically significant change. Changes in confidence in all other capabilities demonstrated positive increases that were statistically significant.

The greatest changes in oral communications confidence are those marked by changes that increased from 16 % to almost 25 %, and are significant at the 0.001 level of probability. They include the ability to develop an appropriate style of speaking for a given audience (21.8 %), to select a style of presentation in general (a change of 20.3 %), and more specifically to use voice quality and eye contact (increasing 16.6 %), and being able to answer questions effectively (an increase of 19.7 %). The greatest improvement of 24.6 % was the student's confidence to be able to combine media for a talk, an activity that was demonstrated in final presentations at the end of the Oral Communications program (Fig. 3 shows the details).

Application Period Two—Teamwork. The greatest changes in self-efficacy for teamwork are those marked by changes that increased around 20 %, and are significant at the 0.001 level of probability (Fig. 4 shows the details). They include the ability to work effectively with dislike team-members (21.3 %) and be accountable (18.2 %).

Students' Feedback (Open-Ended) Survey. At the end of each Application Period, the participants were asked to answer their learning satisfaction in terms of their Application Period experiences. The survey included 6 items (Fig. 5 shows the details) on the scale of 1–5, with 1 being "not at all positive" to 5 "extremely positive". Particularly, one item referred to "2.x/3.x skills" means the interpersonal skills from the university Learning Outcomes Framework.

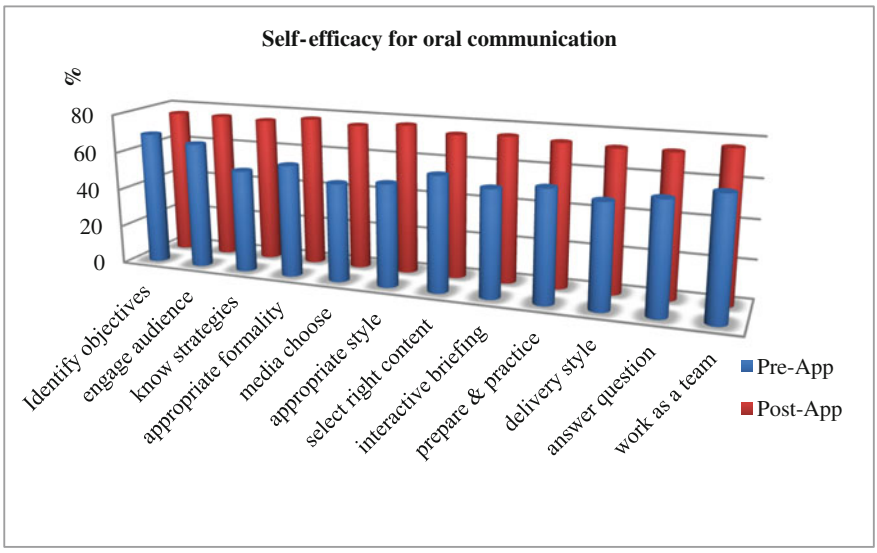


Fig. 3 Students' self-efficacy for oral communication for application period one

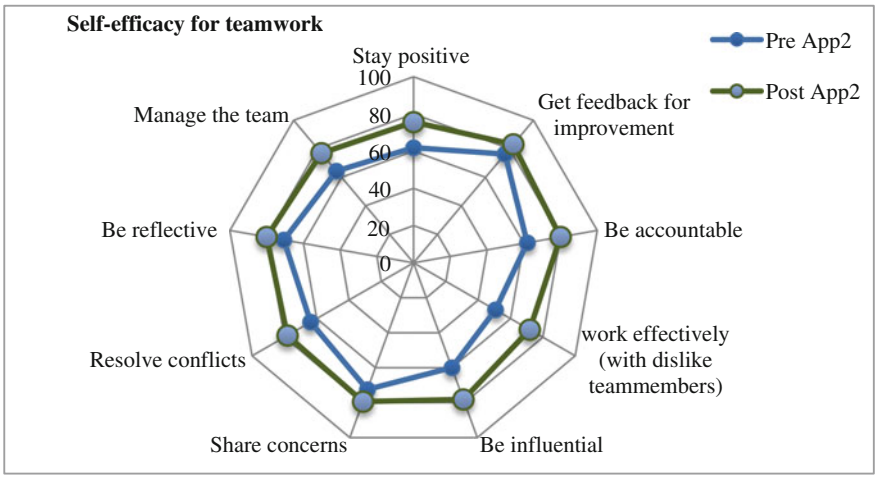


Fig. 4 Students' self-efficacy for teamwork for application period 2

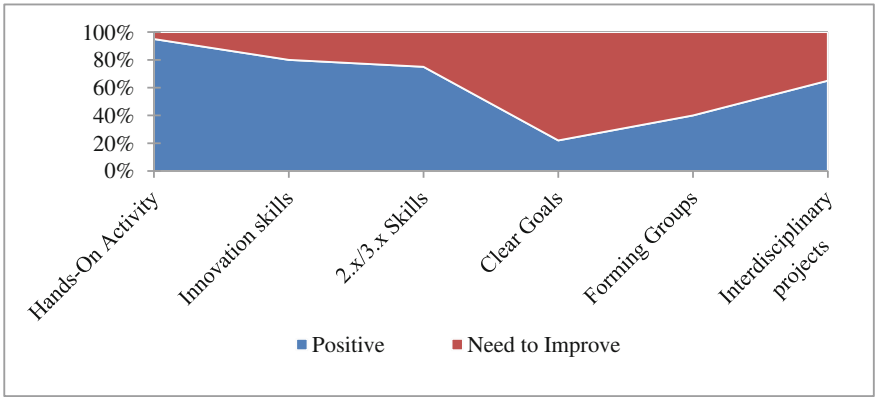


Fig. 5 Students' feedback survey

5 Discussions and Implications

The present study combined qualitative and quantitative methodologies to provide significant information that helps examine how authentic learning and self-efficacy for interpersonal skills impact learning achievement in interdisciplinary engineering education. The results of this study have verified the main themes and connections between the CDIO Learning Outcomes Framework and the pedagogies for the interdisciplinary studies program: *Innovation and Hands-on capability (authentic cognitive learning)*, *Goal-setting* (motivation), and *Teamwork and Leadership* (interpersonal skills).

5.1 Using Self-efficacy for Interpersonal Skills as an Assessment in Engineering Education

Unquestionably, it is important for educators to build students' knowledge of the content in engineering. However, doing so without considering increasing interpersonal skills may do little to improve students' learning effectiveness. Personal factors, such as enthusiasm and creativity, may positively influence attention to memory for new knowledge, and thus increase self-efficacy [3]. That is to say, it might be efficient to raise an individual's self-efficacy through the process of communicating and team building and facilitate learning effectiveness.

5.2 Assessing the Intended Learning Outcomes of the Application Period

In engineering education, the dynamics of current curriculum focus has been constructed through an ongoing process of focusing on how students learn mathematics more effectively based on cognitive thinking and reasoning, which are the significant elements in self-regulated learning. Self-regulated learners are intrinsically motivated to engage in setting goals for themselves, finding effective strategies to achieve their goals, monitoring the process of their strategic thinking and reasoning, and evaluating the self-initiated metacognitive learning process. In this study, the Russian engineering students were intrinsically motivated and interested in the process of authentic learning (e.g., creating prototypes in energy consumption for solving real-world problems). Specifically, the final presentation for the Application Period to the public played a significant role in motivating students to participate and complete the project. They saw the final presentation as a great opportunity to get feedback and let peers, administrators, or industrial business to acknowledge their work.

Finally, when the students engaged in "collaboration" or "group discussion", the immediate feedback and meta-cognitive prompt from the facilitator is a critical indicator for students' learning achievement in engineering education. However, teaching "Teamwork" and how to "Collaborate" is a challenging topic in engineering education. Numbers of students reflected that they did not know how to work with the people they didn't agree with or they didn't like. Some students were just enforced to give up participating because their opinions were not accepted. Instructional designers, instructors, and researchers in the related filed may need to focus on elaborating what "collaboration" or "teamwork" is and why it is important for students to work on besides designing and prototyping products. It shouldn't be just "catching" students not participate. It's about educating them how to respect others' opinions and how to be an innovative entrepreneur (with pedagogies and values).

References

1. Jonassen, D.H.: Instructional design models for well-structured and III-structured problem-solving learning outcomes. Educ. Tech. Res. Dev. **45**, 65–94 (1997)
2. Armstrong, P.J.: The CDIO syllabus: learning outcomes for engineering education. In: Rethinking Engineering Education, pp. 45–76. Springer, US (2007)
3. Bandura, A.: Self-efficacy: The Exercise of Control. Van Nostrand, Princeton, NJ (1997)
4. Deci, E.L., Ryan, R.M.: Self-determination theory. In: Van Lange, P.A.M., Kruglanski, A.W., Higgins, E.T. (eds.) Handbook of Theories of Social Psychology, vol. 1, pp. 416–437. Sage, Thousand Oaks (2012)
5. Yang, Y.S., Gaskill, M.: Exploring personality and perceived self-efficacy for online teaching: a mixed method study. Soc. Inf. Technol. Teacher Educ. Int. Conf. **2011**(1), 862–867 (2011)
6. Crawley, E.F., Malmqvist, J., Lucas, W.A., Brodeur, D.R.: The CDIO syllabus v2.0: an updated statement of goals for engineering education. In: Proceedings of the 7th International CDIO Conference, Copenhagen, Denmark (2011)
7. Crawley, E.F., Edström, K., Stanko, T.: Educating engineers for research-based innovation-creating the leaning outcomes framework. In: Proceedings of the 9th International CDIO Conference, Cambridge, MA (2013)
8. Bryman, A.: Paradigm peace and the implications for quality. Int. J. Soc. Res. Methodol. **9**, 111–126 (2006)

Keeping the HF/UX Curriculum Current with the Critical Decision Method

Lisa Jo Elliott

Abstract Vicious problems are problems that reinvent themselves. One vicious problem is how to educate the next generation of usability (UX) professionals. I borrowed a method from naturalistic decision-making research: the critical decision method (CDM). A CDM is an ethnographic approach that elicits the implicit knowledge of experts in their area of expertise. The methodology reveals the decision points, options, and outcomes with which a decision maker struggles. The decision points derive key attributes, meanings, and goals for the area of concern. UX businesses have a vicious problem similar to education: whom to hire for a UX position, who is qualified and who is not? I used the critical decision method to elicit required skills within the local UX market. These contributed to a reworking of the UX curriculum. The methodology and the results are discussed.

Keywords Curriculum · Usability · UCD · UX · Education · UX skills

1 Introduction

Each academic year educators face the task of updating the usability curriculum. One of the key challenges of this task is how to keep pace with the ever-changing skill set required for an emerging usability professional. As the discipline matures, new skills are required. Those businesses who hire for the emerging trends early can, and do profit substantially. UXers trained in these emerging skills also benefit by being eligible for the best opportunities. Thus, it benefits educators to adopt the latest industry trends if their students plan to enter industry upon graduation.

Discovering these trends is difficult. Online magazines tout the latest practices, yet if one is not currently practicing UX, it can be difficult to understand how these

L.J. Elliott (✉)
Missouri Western State University, St. Joseph, MO, USA
e-mail: lelliott3@missouriwestern.edu

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practices intertwine. Academic guidance in UX education has conflicting advice concerning the topics that need to be covered, the latest methodologies, and the best practices.

Cognitive Engineering researchers have created methodologies to address similar data collection challenges in naturalistic decision-making problems. Naturalistic decision making methods have provided insight into how professionals make decisions in the real world. In these studies, researchers collect information on the cues, goals, decision points, options, attributes, and meanings—which vary from profession to profession. Klein and colleagues [1] have refined a methodology originally created by Flanagan [2] to discover this information in a qualitative manner.

1.1 Critical Decision Method

Flanagan first described the critical incident technique (CIT) in 1954 [2]. He used the technique for a requirements analysis in which the purpose and the outcome of the task was well-defined. One of Flanagan's original studies elicited requirements for an instrument panel design. In Flanagan's original work, he suggests eliciting examples of extreme incidents as the ideal because it is more salient.

Klein's naturalistic decision making theory [3] relies on an adaptation of the critical incident technique and is named the critical decision method. The critical decision method (CDM) is used to explore how people use experience to make decisions in their field [4, 5]. Orasanu and Connolly cite eight factors which characterize a setting for a CDM. They state that these factors are ill-structured problems, uncertain dynamic environments, shifting or competing goals, action/feedback loops, time stress, high stakes, multiple players and organizational goals/norms [6]. A CDM is ideal for situations with incomplete and imperfect information such as hiring a new employee. According to Klein the CDM elicits information about the large corpus of patterns an expert acquires over her or his years of practice within the profession. The patterns help the expert to understand which cues are important and which are not [4].

Hiring an UXer for the real working world fits the definition of an ill structured, shifting, and dynamic task. Often, a good employee is nearly invisible as their behavior fits seamlessly into the organization. A bad employee is very visible because their every behavior and decision noticeably grates. While creating good employees is the goal of every educational institution, it is equally important to avoid creating bad employees. While this paper cannot guarantee a formula for either, it can recommend tools for use in improving the curriculum and aligning it to the local UX needs. These tools were used to discover the UX needs within a specific locale in the Silicon Prairie. A similar effort conducted somewhere else may produce different results.

2 Methods

First, I contacted professionals in UX within my local area, and explained the curriculum quality improvement project. I asked if I could take notes during our conversation and share what they told, to help determine what to teach UX students. One UX professional recognized the procedure immediately. However, understanding the purpose, this person did not mind. The results discussed are gathered from conversations with more than 25 women and men, all with five or more years' experience in UX practice and experience in assessing the employability of new UXers.

2.1 Questions

In general, I asked employers these loosely structured questions. The questions were designed to elicit stories.

- Tell me about your best/worst intern
- What was her or his' best/worst performance
- When you interview, what has been the best/worst interview
- In your opinion, what is the best/worst UX educational institution
- What has been your overall experience with new UX employees

Then, after the discussion, I reviewed my notes and constructed themes. As the themes emerged, I identified categories of skills and rated them according to the emphasis with which I had experienced them in the discussions. This is a slight departure from the CDM methodology [7]. This analysis method was necessary to address the question; which skills need to be included in a UX curriculum [8]?

3 Results

3.1 Overview

Often, in usability studies, users will say something like, "this app works just like Google Maps." Throughout the discussions with employers no one said, "make your program like University State's program, it's the best." This suggested that there is no universally admired program and that there is room for curriculum improvement.

All of the discussions with employers centered on the roles of UX Researcher or Interaction Designer. When asked if these roles also created icons or "the look" for the application, most employers stated that they either had a graphic artist on staff for design decisions or they had user interface designers separate from interaction designers.

Several employers stated that some skills were poorly understood by academics. They would rather train that skill than try to un-train it. I recorded this response primarily for user testing. No one made this comment in connection to wire-framing, card sorts, or heuristic analysis.

I also looked for textbook suggestions or web resources but found no consensus. In both cases, I found a mix of answers. Some practitioners had been educated on the West Coast and favored Jakob Nielsen/Don Norman style fundamentals. Others had been educated on the East Coast and favored Jared Spool style fundamentals. Furthermore, others had a non-UX related background and worked their way into UX through graphic design or advertising. I was also surprised to find that while I considered UX to be a part of Human Factors, it was clear that many others did not; they considered UX to be a different profession entirely.

Prior to undertaking this project, I anticipated that I would get a list of software that the students needed to know and specific methodologies in which they should demonstrate proficiency (i.e. Heuristic Analysis). In some instances, specifics like this emerged, but overall the emphasis was on soft skills rather than hard skills. One person stated, "Software changes all the time. This week we are using OmniGraffle, but next week there could be something new. Students should be adaptable and be able to learn software fast." Someone else stated, "As long as they know one prototyping program, one team communication program, and one visual design program, we can go from there. It is the initial effort in learning these types of programs that counts." Another person stated, "We screen for the hard skills and hire on the soft skills." In this context, soft skills are considered to be behaviors.

3.2 Soft Skills

From this perspective, it became clear that the curriculum overall needs to focus on soft skill development. Soft skills can take many months or years to master. The soft skills that the employers mentioned centered around four themes: process, development, interpersonal relations, and leadership.

Process. In terms of process, students need to be able to deconstruct something into its essential parts. They need to understand that it is great to have a prototyping program on your computer, but sometimes paper and pencil is a better set of tools because it breaks down barriers between the UX person and the client. The client can just as easily draw what she or he has in mind. This was also reflected in the discussion of design thinking. Adjacent to this theme is the understanding of determining the key problem and determining how to test it.

Development. In terms of development, agencies were using Lean. They stressed that all class projects should follow that model. Yet large corporations were using Waterfall and stressed documentation. Students need to be able to present and document carefully and thoroughly. Even in the Lean environments, the need for documentation has shifted to cell phone pictures and white board drawings but it has not gone away entirely.

As a UX professional, students need to demonstrate empathy toward both the stakeholders and the developers. Students need to be able to adjust their message to many different audiences, identify executables—when it is time to stop and test, or when can the testing wait. In contrast, how much testing, and how to do the testing, did not seem as important. Overall, employers stressed networking, collaboration, collegiality, working with the strengths and weaknesses of others, and learning new software rapidly.

Interpersonal Relations. Employers want students who can understand and deal with constraints or dependencies instead of complain or try to change them. Employers want them to understand what it is like to think like a programmer and be able to adapt to different development approaches such as Lean. The strongest point that employers stressed in this area covered how to negotiate and how to deal with pushback within an organizational structure.

Leadership. Several employers stressed that students lacked soft skills when it came to interacting with users. Students need to understand how to work with a wide range of people, most of whom are unlike themselves. They need to "respect the locals" and remember the acronym "LRQ- listen, respect, and question."

Employers stressed that a student's skill with stakeholders was almost as critical as their skill with colleagues. Many students failed to understand a business model or the idea of a paying client. Students have become accustomed to lenient professors who fail to teach time management. Employers noted that students did not know when to lead development and when to follow development forward. This statement included how to get people to do stuff during meetings and during user testing, as well as what are appropriate behaviors and conversations in a workplace.

The themes related to leadership and perceptiveness were mixed—some employers stated that these were very important while others did not mention perceptiveness at all. Some employers stated that students must to be able to read a situation during user testing or during an interview to determine when it is beginning to sour. Students should understand how to back away and how to rescue or prevent a bad encounter. Overall, the organization and the product's reputations are vulnerable during user testing. Testing protocols therefore could not be rigorous enough.

In addition, employers addressed the need for students to see the deep meaning when reviewing the results after testing. Students often miss how the design relates to the primary goal of the application and to the client's business objectives. The students need to understand the application from the stakeholders' perspective. They need to understand what impact their design choices would have on each group of stakeholders. They also need to be able to tailor a design to fit the requirements of different user groups. They need to be able to lead development through processes that would help the developers to solidify design and understand the user.

3.3 Hard Skills

Software. In terms of software, employers stated that students should know a wire-framing or prototyping tool, a testing tool, and a team or communication platform to manage projects. They stated that these tools are currently in a state of flux. Some teams preferred one set of tools, but then the tools change, or the organization is unable to afford the high cost of a particular tool. Then, the UXers must all learn a different tool. However, employers stressed that all of the software within a particular category (i.e. wire-framing), operate in the same way. If a student understands one, it is easier for them to transfer to another tool within the category.

Hardware. Students should know how to use at least two platforms within the iOS, Windows, Android frameworks. Within the platforms, students should be familiar with the scalability between devices (i.e. mobile to desktop and the reverse). They should also understand how a single application or website changes between platforms. Their designs should be both scalable and platform agnostic.

UX Methods. Amongst all of the discussions, employers agreed that all students should have a toolkit of a few basic methods. These are:

- Prototyping
- Wire-framing
- Sketching
- Heuristic analysis
- Card sorts
- User testing

Agencies and small organizations stressed that students should have a design process. Students should know about patterns, how to plan a project, storyboarding, and how to annotate wireframes. In addition, employers sought students who could perform both High and Low fidelity testing, A/B testing, and conduct think aloud protocols during field-testing. Discussions with employers who worked for large corporations centered on personas, scenarios, and extensive ethnography. Yet those who worked in agencies or smaller firms stated that they often did not have the time or budget for extensive ethnographic work.

Other. Some employers wanted students who could develop surveys, conduct an interview, and lead a focus group. This theme was not universal across all employers. In contrast, the theme of being able to write a clear and concise report was universal. Nearly all employers mentioned a student's ability to present the same data in different ways to different groups of stakeholders or developers.

Personal Attributes. Students who enter UX should love technology and not be afraid of it. The student should be a good listener, a collegial team player, and have a good rapport with the public. Universally, the employers wanted students who were likeable and who had a positive presence when they entered a room.

Surprises. Over all of the discussions, the word "theory" was not mentioned at all. In fact, theory is what employers complained about most. They said that interns often come to work "with their heads loaded with statistical analyses and

experimental methods" and "with no idea how to apply it to the real world." Above all, employers emphasized that students need to know how to do real projects with real development teams. Students need to be able to get the critical answers out of the development team and users quickly and simply. Students need to be able to identify problems, find the correct methodology to address the problem, and then understand the solution within the data.

Topics that never came up in the discussions were:

- affordances and constraints
- automation and situation awareness
- accessibility testing
- cognitive theory
- social psychology theory
- sensation/perception theory

Other surprising things that employers said were that each sector of UX required additional skill sets that other sectors did not. For example, in medical UX, the person must be able to watch an IV line as inserted into a patient by a nurse, and the person should be able to work with the large personalities in the medical sector. For accessibility UX, the person must be able to view accessibility modifications as a normal part of the development process. Employers who shared this information also shared that these attributes could not be faked; they could easily spot students who did not have skills in these areas.

References

1. Crandall, B., Klein, G., Hoffman, R.R.: Working Minds: A Practitioner's Guide to Cognitive Task Analysis. A Bradford Book, The MIT Press, Cambridge (2006)
2. Flanagan, J.C.: The critical incident technique. Psychol. Bull. **51**(4), 327 (1954)
3. Klein, G.A., Orasanu, J., Calderwood, R., Zsambok, C.E.: Decision Making in Action: Models and Methods. Ablex Publishing Corporation, Norwood (1993)
4. Klein, G.: The Power of Intuition. Doubleday, New York (2003)
5. Janis, I.L.: Decision making under stress. In: Salas, E., Klein, G.A. (eds.) Linking Expertise and Naturalistic Decision Making. Psychology Press (2001)
6. Orasanu, J., Connolly, T.: The reinvention of decision making. In: Decision Making in Action: Models and Methods, pp. 3–20. Ablex Publishing, Westport (1993)
7. Klein, G.: Sources of Power: How People Make Decisions. The MIT Press, Cambridge (1998)
8. Richards, L., Morse, J.M.: README FIRST for a Users Guide to Qualitative Methods, 3rd edn. SAGE, Los Angeles (2013)

Virtual Environments for Competency-Oriented Education and Training

Thomas Alexander, Martin Westhoven and Jessica Conradi

Abstract Highly trained soldiers are essential for successful military missions. Soldiers have to be optimally prepared to make the right decision and act successfully under complex and dangerous conditions. An optimal preparation requires a holistic approach, taking training objectives, content, processes and technologies into equal consideration. The recent military standard for education and training, which is just being updated by German military authorities, focuses a competency-oriented approach rather than training objectives. The military standard also highlights self-organized learning and quality management as essentials. This is not learned but experienced. Virtual Simulation and especially Virtual Reality (VR) and Virtual Environments (VE) are seen as innovative technologies with high potential. They allow for experiencing a broad range of training scenarios in a safe environment. Especially competency-based training can be supported by such innovative technologies. This paper will elaborate the potential of applying these technologies for enhancing and supporting competencies.

Keywords Virtual environments · Simulation · Competency-oriented training

1 Introduction

Today's and future military missions require highly trained and capable military personnel. Soldiers have to be well prepared to use complex, state-of-the art technology under highly complicated, unclear and rapidly evolving conditions in

T. Alexander (✉) · M. Westhoven · J. Conradi
Fraunhofer-FKIE, Department of Human Factors, Zanderstrasse 5,
53117 Bonn, Germany
e-mail: thomas.alexander@fkie.fraunhofer.de

M. Westhoven
e-mail: martin.westhoven@fkie.fraunhofer.de

J. Conradi
e-mail: jessica.conradi@fkie.fraunhofer.de

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diverse environments. In parallel, the spectrum of military missions has been significantly expanded and includes humanitarian aid, disaster relief and peacekeeping operations as well. These missions have in common that soldiers act in a highly dangerous environment with a lot of uncertainty and no tolerance for errors and wrong decisions. In addition, soldiers communicate and interact closely with the local population. This requires skills and competencies far beyond "traditional" military skills, e.g. intercultural and communicative skills and competencies. In addition, military command culture is shifting from strict orders towards more general, task-oriented orders. This gives more degrees of freedom to the operational units but requires innovative command cultures and competencies.

As a matter of facts, military education and training is currently being revised by German military authorities. The recent military guideline for education and training on "Fundamentals of education" focuses on a competency-oriented approach rather than traditional training objectives [1].

Very briefly, competency describes the ability and potential of a human to act. It is understood as the "ability and willingness to use individual knowledge, skills and abilities as well as personal values and attitudes in a military practice" [1]. Competency clearly addresses the available and learnable skills and abilities of an individual for solving special problems. This includes motivational, volitional and social willingness and ability for solving these problems in varying situations in a successful and responsible manner [2]. Competency is, thus, essential for acting effectively and efficiently in any situation. Performance is a way to demonstrate and quantify this potential [3].

A successful, competency-oriented training approach requires [4, 5]:

- reference to the trainee/subject,
- reference to the biography of the subject,
- interaction,
- cooperation,
- experience,
- reflection.

An active participation and involvement of the trainee supports this approach significantly. The competency-oriented approach supports a continuous reflection of educational content and topics. These topics are closely connected to practical situations and applications. Therefore, practical situations in operational environments serve as a basis for education and training. Learning always refers to the full story line and action, which is taught and should be executed actively. If this is not possible it allows to reproduce it notionally. Learning is self-organized so that trainees plan, perform and analyze their own process of learning. This emphasizes the balance between guidance and independence. Moreover, actions refer to a holistic awareness of the complex situation, including not only isolated aspects, but technical, safety-relevant, economic and social aspects as well as consequences of their actions. These actions are deeply based on the experiences of the subject [6].

It is summarized that learning is becoming more self-organized and self-paced. Most of the content is not presented but actively experienced. In addition, learning is not limited to special courses but extends to learning-on-the-job and life-long learning.

It is important that training policy, procedures, and technologies provide adequate means to prepare soldiers for the full-spectrum of situations they are likely to encounter. Providing and supporting relevant competencies it is a promising way to do so [1].

2 Simulation and Virtual Environments

Today's education and training concepts tightly and successfully integrate Simulation. It describes the imitation of the real world based on a model. The model represents the key characteristics, e.g. physical appearance, and behaviors of the system. Simulation is frequently used when real situations are either too expensive or too dangerous to experience in reality. This makes it an important medium for education and training [7, 8].

Virtual Reality is a special kind of simulation. The idea of generating and using a realistic computer-generated Artificial or Virtual Reality (AR/VR) has been mentioned in science fiction literature long ago. Today's VR-systems are commercially available and already used for a broad range of applications [9]. In general, VR describes the computer-based generation of an intuitively perceivable and experienced scene of a natural or an abstract environment [10]. There are different types of VR as shown in Fig. 1. They allow a varying degree of immersion, i.e. the "feeling of being there", of being involved in the synthetic environment.

NATO HFM-021 has defined Virtual Reality (VR) as [11]:

> … the experience of being in a synthetic environment and the perceiving and interacting through sensors and effectors, actively and passively, with it and the objects in it, as if they were real. Virtual Reality technology allows the user to perceive and experience sensory contact and interact dynamically with such contact in any or all modalities.

VR-technology is becoming widely available for diverse military applications. Its applicability depends on the comprehensiveness and fidelity of underlying



Fig. 1 Different types of VR: handheld, projection, head-mounted display

digital models. Both are very high in terms of visual and acoustic presentation of the environment. However, as soon as manual functions and tasks become dominant it may be easier to use real hardware instead of a sophisticated virtual simulation. VR is being applied successfully at several military training facilities.

VR technology has grown from its original focus on training to applications, that include systems engineering, mission rehearsal and mission execution. Moreover, with serious gaming and commercials-of-the-shelf it is possible to facilitate efficient and effective training, and make it available at different or even distributed locations. The effectiveness of these applications will not only be dependent on the extent to which AR/VR meets the ergonomic requirements of human operators but also on the individual experiences with similar technologies. This also will result in new requirements for training and in changes for learning management [12].

3 Competencies and Virtual Reality

VR allows trainees and human operators to experience synthetic, computer-generated training environments that prepare them for the tasks to be performed in a realistic and safe way. Ideally, trainees should perceive the same cues in the synthetic world that they would experience in the real world. They should be able to interact with complex synthetic systems as if they were real. In this connection, AR/VR subsume new types of paradigms and technological media that can provide a realistic training environment and a natural human-system interface by applying new interaction techniques and interface technologies.

By combining safe training environments with a high degree of realism, it is possible to develop and enhance individual competencies. Trainees can experience full actions in a realistic environment. VR is highly interactive by definition, which supports a successful, competency-oriented approach. Mission-rehearsal capabilities facilitate reflection and so feedback can be provided easily.

The main benefits of VR technologies are their relatively low costs ("serious gaming") and large number and spectrum of application areas. An identical hardware is applicable for various purposes. It only relies on general-purpose computers, displays and effectors that are not physical representations of the real systems. This flexibility facilitates one particular system to be used to model and train a variety of tasks with common requirements for the human interface. However, VR is only a technology and the effectiveness of VR technologies strongly depends on the task to which they are applied. Although VR is capable enough to accomplish real time applications and part task training, research is still needed in other areas. This is true for the integration into current education and training concepts.

With regard to other requirements of a competency-oriented approach, it has to be mentioned that VR neither covers the close reference to the trainee/subject nor a reference to the biography of the subject. VR is considered as a training medium

rather than a training system. However, an individualized Learning Management System (LMS) connected to the training system can address these two requirements.

Still, VR is not capable to replace reality and live-simulation "out in the field". Current representations of environmental stimuli do, not include e.g., "mud and dirt" experiences. VR technologies can contribute to effective training strategies but they will not totally replace other education and training methods or environments. This is particularly true for live training and building competencies in reality, with real and not simulated people. Even though technology is capable of simulating many aspects of the real world, there are limitations. While tactics and maneuvers can be performed in VR, trainees will always need to experience the physical demands and conditions of the real world. Instead, VR will help prepare soldiers for live training by broadening the spectrum of the situations the soldiers have encountered prior to training on live ranges. Virtual simulation can support the effectiveness of live training with the introduction of computer-generated targets and virtual humans.

4 Virtual Reality and Human Factors Issues

For a reasonable application of VR it is necessary to include basic human characteristics and capabilities. There are multiple dimensions for this starting with human information processing. However, there is no fully functional model of human perceptual, cognitive, and motor behavior, and this still requires empirical analyses for an optimal VR design. Moreover, several studies in this area are based on subjective ratings rather than objective measures. Perception is the basis of human information processing. With reference to VR and its experience, it makes sense to analyze each modality of perception separately. There are special characteristics and limitations of human perception, which hinder the information transfer or even lead to unwanted negative effects or after-effects. One example for this is simulator sickness. It can occur in different degrees: starting from simple disorientation, it can lead to serious dizziness or nausea. Simulator sickness is caused by a sensorial conflict between virtual and real stimuli, especially between visual feedback indicating motion and kinesthetic cuing. Reduced image quality aggravate this phenomenon. Other factors which have been identified as contributors to simulator sickness in virtual environment systems are divided into [13, 14]:

- characteristics of the user,
- the system and
- the task.

There are various studies to determine the effects of VR technology on simulator sickness. Hence much of the evidence for the effects of these factors comes from studies of visually induced motion sickness and motion-induced sickness (i.e., sickness caused by actual vehicle motions), as well as the effects of exposures to simulators.

5 Training Fast Decision Making for Urban Operations

For our practical application, we are focusing military operations in urban terrain. Such operations are characterized by various factors, which make them very dangerous for soldiers: Factors included are unclear situations and very close interaction with other people. Peaceful situations during humanitarian aid might develop into combat in little or nearly no time. Soldiers have to act under high pressure and high workload. It is essential that they are well prepared so that they make correct decisions under these conditions. Errors are not an option and lead to serious consequences. Perception and subsequent decision making is, thus, the main training objective.

It is essential that soldiers sense, perceive and process each situation to estimate if it is safe or dangerous. This is not trivial in unclear situations outside of buildings but inside it is even more difficult. Usually, these scenarios are trained in special urban facilities by life trainings and live simulation. Trainees examine and clear buildings and teachers observe their behavior and action and provide feedback. It is common that the buildings are not populated. Consequently, feasibility and realism of the training environment is limited.

In our approach, we train perception and subsequent basic decision making by introducing VR as a virtual simulation. This way it is possible to individualize training and overcome the shortcoming of missing people. This clearly does not replace live-training but allows additional functionality. First feedback from our proof-of-concept is positive and we plan to extend our approach in future. A snapshot of the visual quality of the VR is shown in Fig. 2.



Fig. 2 Visual impression of VR for MOUT training: the task is to find and correctly identify friend and/or foe

By introducing VR as a training tool, it is possible to add realism and interactivity to training environments. Trainees can experience more training situations under controlled conditions. By providing feedback, it is possible to add new ways for reflection and feedback of experiences and actions. This makes VR a promising tool in a competency-oriented training approach.

References

1. Marstaller, A.: Ausbilden für die Streitkräfte. In: Proceedings of the Ausbildungskongress der Bundeswehr, Hamburg: HSUniBw HH 09/2015
2. Weinert, F.E. (ed.): Leistungsmessungen in Schulen, Weinheim und Basel (2001)
3. Katzky, U.: Kompetenz und Performanz. In: Proceedings of the Ausbildungskongress der Bundeswehr, Hamburg: HSUniBw HH 09/2015
4. Arnold, R.: Kompetenzentwicklung und Organisationslernen, pp. 86–110. Vogel (1998)
5. Roth, H.: Pädagogische Anthropologie, Bd. 2, Schroedel (1971)
6. Gillen, J.: Kompetenzorientierung und aktuelle Entwicklungen in der niedersächsischen Lehrerbildung. Workshop of BAK Hannover, 12 Nov 2014
7. NATO MS Strategic Plan. NATO MS Strategic Plan Ver 2.0 endorsed_by_STB_14Sep 2012. http://ftp.rta.nato.int/Public/Documents/MSG/NATO_MS_Master_Plan_Web.pdf
8. Swezey, R.W., Andrews, D.H.: Readings in Training and Simulation: A 30-year Perspective. HFES, Santa Monica (2001)
9. Alexander, T., Goldberg, S.: Virtual Media for Military Applications. RTO-MP-HFM-136. NATO RTO, Neuilly-sur-Seine, FR (2007)
10. Bullinger, H.-J., Brauer, W., Braun, M.: Virtual environments. In: Salvendy (ed.) Human Factors and Ergonomics, pp. 1725–1759. Wiley, New York (1997)
11. Alexander, T., Goldberg, S.: Virtual Environments for Intuitive Human-System Interaction—National Research Activities in Augmented, Mixed and Virtual Environments. RTO-TR-HFM-121-Part-I. NATO RTO, Neuilly-sur-Seine, FR (2005)
12. Alexander, T., Goldberg, S.: Improving Human Effectiveness Through Embedded Virtual Simulation. RTO_MP-HFM-165. NATO RTO, Neuilly-sur-Seine, FR (2014)
13. Kennedy, R.S., Lane, N.E., Berbaum, K.S., Lilienthal, M.G.: Simulator sickness questionnaire: an enhanced method for quantifying simulator sickness. Int. J. Aviat. Psychol. **3**(3), 203–220 (1993)
14. Renkewitz, H., Alexander, T.: Perceptual issues of augmented and virtual environments. In: Alexander, T., Goldberg, S. (eds.) Virtual Environments for Intuitive Human-System Interaction. RTO-TR-HFM-121-Part-II. NATO RTO, Neuilly-sur-Seine, FR (2007)

Part II
Commitment and Motivation in Management and Leadership

Delphic Maxims Based Applied Philosophy for Business and Governance Management

Evangelos Markopoulos and Hannu Vanharanta

Abstract Knowledge analysis and representation is significant in defining situations before they are implemented through action. Knowledge engineering precedes knowledge management and knowledge utilization needs knowledge creation. In the race for capturing and mastering knowledge, emphasis is given to the development of intelligent methods and tools to understand the human mind, but not the human being itself. To tackle this complexity, it is necessary to seek knowledge in non-trivial sources via root cause analysis models of philosophical wisdom, which usually provides the answers. As problems become more complex over time, synergies of knowledge disciplines are critical and necessary. This paper presents a triadic categorization approach, based on classes, taxonomies, and ontologies of the Delphic Maxims, and their analysis by cognitive models in an attempt to reveal their contribution to modern business and governance management through the essence of the Hellenic contribution to the global economy, civilization and humanity.

Keywords Applied philosophy · Knowledge management · Business management · Governance · Strategy · Leadership

1 Introduction

Knowledge is the key word in research, development, achievement, progress, prosperity, success and anything that can be associated with creativity and wisdom. Knowledge drives all progressive activities, initiatives, projects, processes, and

E. Markopoulos
School of Technology, Department of Production, University of Vaasa (UVA),
65101 Vaasa, Finland
e-mail: epm@empross.com

H. Vanharanta (✉)
Tampere University of Technology (TUT), Industrial Management,
Pohjoisranta 11 A, P.O. Box 300, 28101 Pori, Finland
e-mail: hannu.vanharanta@tut.fi

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anything that can be considered a step ahead in professional and personal development [1]. Furthermore, true knowledge is power, and power is freedom, in contrast to ignorance, which can be seen as slavery. Those who have knowledge are really free, not only to reach truth but also to create through truth. Human beings cannot possess anything that they do not perceive, interpret and understand. As the circles of mind grows, so does the circumference of the darkness around it, verifying Socrates' words "This one thing I know, that I know nothing" [2]. On the other hand, having knowledge alone is not enough. Knowledge has a nature of a tool, and tools can only be effective in the hands of the person who holds them properly and wisely. Knowledge can contribute creatively but also destructively, unless developed within ethical, and not only legitimate, principles [3]. Despite the fact that knowledge is certainly a magic recipe, it has always been extremely difficult to define what knowledge is and what it is not. Once such a distinction can be achieved, at least to a degree, then anything related to knowledge can be significantly improved, starting from the knowledge elicitation process, all the way to knowledge utilization and capitalization. The distance between knowledge creation and knowledge utilization is vast, as there are many steps that interfere in this interpretation and transformation of knowledge into something that can indeed be capitalized successfully, effectively, and rewardingly [4]. The need for the development of more affective classification models and methods in order to apply them in understanding the various civilizations of humanity towards true knowledge generation is paramount. It is vital for the progressive continuation of the modern society and economy to learn from the knowledge of the past and utilize it today to progress with it to the future.

2 The Delphic Maxims

An important source of knowledge that contributed significantly to the development of humanity is found in the Delphic Maxims of the Hellenic civilization.

The Delphic maxims are aphorisms said to have been given by the god Apollo's Oracle at Delphi [5]. The maxims are 147 commandments composed in the 6th century B.C. that include much of the wisdom and the teachings of ancient Hellenes in laconic sentences, written in the area of the Delphic Oracle. Located at Delphi, on the slopes of Mount Parnassus, home of Pegasus, the Oracle was built at the place considered the Navel of the Earth, the center of the world. The maxims themselves are also known as "The Commandments of the Seven," and are said to have been written by the seven sages of Ancient Greece at Delphi, where they were inscribed. The seven sages were Solon of Athens, Chilon of Sparta, Thales of Miletus, Bias of Priene, Cleobulus of Lindos, Pittacus of Mitylene, and Periander of Corinth. The 147 maxims with no more than four words each, carrying deep philosophical meanings, making their classification quite complex depending on the interpretation given.

3 Analysis Approach

The universal meaning of the Delphic Maxims can be approached thorough multidisciplinary practices and techniques. Ontologies can be used to define the space in which each maxim meaning moves and changes per instance of interpretation and usage. Taxonomies can be used to define the categorization of the maxims, and classes can be used to define the relationships between the elements of each class. Interpreting the Delphic Maxims as applied philosophy of business management and administration could be a significant contribution to the global economy and society. The maxims can be analyzed by their interpretation, application, contribution and have impact in decision making, strategy, leadership, human resources management, goals setting, organizational commitment, ethos and overall entrepreneurial and corporate philosophy. Such an analysis can develop new management frameworks affected by concepts and values for optimal organizational performance based on the best utilization of the capability and maturity of the human resources [6]. Organizations suffer, not because they cannot solve their problems, but because they cannot identify them. Lack of problem identification is due to lack of corporate communication, which in turn is due to lack of corporate culture, which is due to a lack of corporate philosophy on values based on the basic principles of humanity and civilization.

4 Ontologies, Taxonomies and Classes

Ontology derives from the Hellenic 'on' (ὄν), genitive 'ontos' (ὄντος): "of being," and 'logia' (λογία): science, study, theory. Taxonomy derives from the Hellenic, 'taxis' (τάξις), meaning 'order' or 'arrangement', and 'nomos' (νόμος) meaning 'law' or 'science'. The breakdown of the Hellenic meanings are: Ontology = science of being, Taxonomy = arrangement science. Therefore, taxonomy is the simple hierarchical arrangement of entities with a parent-child kind of relationship. An ontology, is a more complex variation of a taxonomy as it also defines spaces for taxonomies [7].

The purpose of a taxonomy is knowledge classification, while ontology goes beyond into "knowledge representation". Classes are taxonomical ranks, indicating interrelationships (including inheritance, aggregation, and association), operations, and attributes. The representation of classes can be in a tree or relationship arrangement, based on the properties/attributes of the classes or the behavior a particular class is allowed to perform. An example of the Ontology-Taxonomy-Class relationship could be given with the following example. "To be or not to be?" would be an ontological question. according to taxonomy "you're one of the humans", and based on the classes "you are a Hellene". Therefore, the ontology is the description, the taxonomy is the classification, and the class is the rank or category within the taxonomy of an ontology. Viewing this triadic classification

relationship from a distance, a holistic knowledge representation is achieved not only in understanding large sets of information, but also exploring its interpretation through various paths and relationships. After all, knowledge is obtained by observation.

5 Ontologies of Delphic Maxims

The wisdom of the Delphic Maxims is quite magnificent; therefore the classification of such wisdom can only be approached using ontologies to define the knowledge spaces. Many maxims can ignite different classification knowledge paths in various directions that can be interpreted, analyzed, and applied effectively to both the society and the economy. The core ontologies that can be derived from the Delphic Maxims are as follows: Self Control, Communication, Respect, God (Religion), Justice, Knowledge, Work, Finance, Family, Honor, Love/Care, and Education.

Each ontology presents a number of concepts that can be developed as distinct knowledge categories with their own interpretation based on their dependencies and usage. The way each ontology and ontological structure is applied develops different management approaches under different philosophical thinking.

Example: 'God' imposes 'Love/Care,' which can generate 'knowledge', and through 'respect' and 'work' results in effective 'financial' management. Another way to see the ontologies is that 'knowledge' generates 'self control,' which with 'work' and 'care' results in effective 'financial' management as well. The first approach is based on the triptych 'God-Love-Knowledge' whereas the second is based on 'Knowledge-Self Control-Work.' They both end in effective financial management and the ensuing benefits, but the approach is different, as the first one is more abstract while the second one is more concrete.

6 Taxonomy of Delphic Maxims

Starting from the Delphic Maxims ontologies, numerous taxonomies can be generated from each one. The 'Self Control' ontology may generate a number of taxonomies related to self control, based on the maxims that belong to that ontology. Such taxonomies can be the following: Feelings, Acts, Thoughts, Decisions, Advice and more.

Taxonomies may have similar representation structures with ontologies based on the way knowledge is analyzed. Taxonomies can also lead to the development of

different management approaches under different philosophical thinking. 'Feelings' for example, activate 'thoughts,' which execute 'acts' based on 'decisions'. Another approach to view this taxonomical representation of knowledge can be that 'decisions' are based on 'feelings' and 'acts', triggered by 'thoughts'.

In the first case, the maxims drive a proactive management approach where 'thinking' precedes 'acting', while in the second case the maxims drive a reactive approach where 'acting' precedes 'thinking'. Both approaches result in different strategies for a common goal through different philosophy paths. The relationships between the taxonomies can be not only linear but also conditional.

7 Classes of Delphic Maxims

The Delphic Maxims' Taxonomies can generate many classes for each taxonomy. The 'Feelings' taxonomy of the 'Self Control' ontology can include maxims related to the 'control of feelings'. Some of them are: 'Be grateful', 'Control yourself', 'Pursue harmony', and others. Likewise, the 'Decision' taxonomy of the 'Knowledge' ontology can include maxims related to 'decisions based on knowledge. Some of them are: 'Tell when you know', 'Act when you know', 'Venture into danger prudently' and others The classes contain elements with information that can be presented as a process, or as decision/control mechanisms for a wider process. There are a number of maxims, related to each other for a specific purpose, revealing knowledge in process-oriented approaches/models. For example, the following classes are constructed with a number of elements from one or more taxonomy or ontology.

Class : Act Wisely : {'Be/Know Yourself' > [Taxonomy: Feelings, Ontology: Knowledge], 'Foresee the future' > [Taxonomy: Feelings, Ontology: Self Control], 'Perceive what you have heard' > [Taxonomy: Act, Ontology: Knowledge], 'Nothing to excess' > [Taxonomy: Decision, Ontology: Finance], 'Act without repenting' > [Taxonomy: Act, Ontology: Self Control], 'Work for what you can own' > [Taxonomy: Act, Ontology: Finance]}

The elements of this class create the 'Act Wisely' process. This process states the following: Be/Know Yourself > Foresee the future > Perceive what you have heard > Nothing to excess > Act without repenting > Work for what you can own. When interpreting this class in structured English, the following applied philosophy is generated: Know yourself first in order to foresee the future correctly, then by utilizing what you hear and with no exaggerations start acting, without looking back, to work on what you can own. The 'Act Wisely' class which derived from elements of three ontologies and three taxonomies, on a unique relationship to a specific process.

8 A Triadic Classification of Knowledge

The representation of any type of information and specifically the structured information that generates knowledge, based on the way it is interpreted and analyzed, cannot be classified precisely with a specific classification technique alone [8]. Ontologies for example, indeed provide the high-level representation of knowledge grouped in micro-worlds of information, connected together with various relationships and dependencies. Likewise, taxonomies are derived from ontologies and furthermore classify their information based on more specific categorization schemas, which probably overlap with other taxonomies and ontologies [9]. The discrete line between what type of information can be classified with either ontologies or taxonomies is based on the type of information, the meaning, and the depth of analysis that can be given. Classes, on the other hand, are groups of elements that define the behavior of the information. Classes can be formed with information from one or more taxonomies, with no representation restrictions as classes can be tree-oriented or relationship-oriented. Information that represents knowledge can end up generating classes that can practically turn this knowledge into applied knowledge, composed with elements from different taxonomies and ontologies. In the case of the Delphic Maxims, the classes are philosophical processes applied in small or large procedures, composed of elements from different taxonomies and ontologies (Fig. 1).

This type of information classification could probably considered as one with restrictions on the interpretation of knowledge in the generation of cross-taxonomy and cross-ontology based wisdom. It is that such an unbounded triadic representation of knowledge can be fuzzy and/or hypothetical for knowledge interpretation and classification, but also very rewarding and innovative, if common sense is indeed common.

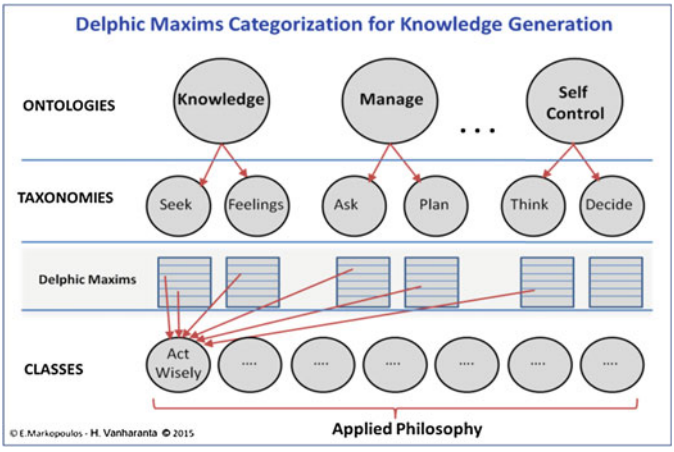


Fig. 1 Triadic classification of knowledge

9 Business Management Relationships

The relationships that can derive from the classification of the Delphic Maxims can provide significant applicability in business management, analyzed either in a complex or simple way within the area of a classification technique. Taking for example some Maxims from a specific ontology, a wise process of thinking and acting can be derived that can guide and drive business management acts, logic and thinking.

An example of maxims in the 'Knowledge' ontology that can generate a business management relationship can be the following: {Know your opportunity, Listen to everyone, Perceive what you have heard, Think as a mortal, Tell when you know}.

Another business management relationship of knowledge can be the 'Self Control' ontology, {Foresee the future, Use your skill, Act quickly, Act without repenting, Do what you mean to do}. Likewise, maxims from the 'Finance' ontology can govern business management relationships such as: {Govern your expenses, Nothing to excess, Work for what you can own, Pursue what is profitable, Benefit yourself}.

The examples given are only a few. Having 147 maxims that encapsulate the entire wisdom of the Hellenic civilization, the knowledge that can be turned into applied philosophy in business management can only be considered as remarkable. In addition to that, if the analysis of the Maxims is extended using a triadic knowledge classification, which enables the creation of business practices with the interconnection of maxims from different taxonomies and ontologies, then the combinations of applied business concepts and processes that can be generated are tremendous.

10 The Holistic Concept of Man Metaphor

The analysis of the Delphic Maxims generates practical knowledge that can be characterized as applied philosophy for management and leadership. In the same sense, the Holistic Concept of Man (HCM), a philosophic metaphor described by the Finnish philosopher and psychologist Rauhala [10], integrates the meaning of the Delphic Maxims in defining a mental-oriented knowledge based engine. Pihlanto and Vanharanta have applied the metaphor in the contexts of accounting research and computerized decision support [11, 12]. Further, Rauhala's ideas have been acknowledged in several disciplines, e.g. theoretical information systems and knowledge management [13]. The concept of the HCM metaphor consists of a body, mind, and situation [14]. The three dimensions of the HCM, representing the modes of existence of the actor or decision maker, are called: (1) corporeality, (2) consciousness, and (3) situationality (Fig. 2).

The three modes of existence are intertwined with each other, forming a holistic entity, where the wholeness of interactive modes builds up a "regulative situational circuit" [10, 11]. Corporeality maintains the basic processes of existence emergent expressed as physical activities of the human being. In particular, the human brain and sense organs are important in conveying objects and concepts to the decision maker as meanings in a specific situation. Consciousness stands for experiences and

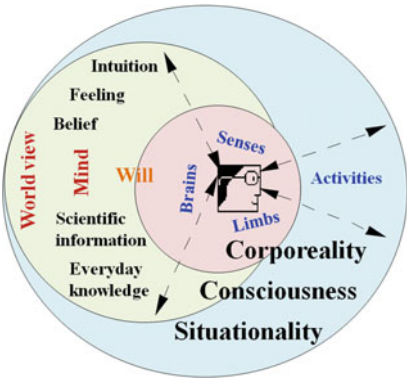


Fig. 2 The holistic concept of man: mental—physical contrast

perceptions. It enhances understanding of various phenomena both inside and outside of oneself. Human beings use their outer and inner senses to receive physical signals from the environment in a certain situation, providing the consciousness with meaningful content. Perceiving and understanding the object/concept/relationships make a set of meanings emerge, available for use in the decision making process. Situationality is the decision maker's relevant relations to the outer world, in all its multifaceted pluri-dimensionality. The situational components can be concrete or ideal, the former including nature, buildings, technological equipment, hardware and software, and the latter human values, norms and human relationships as experienced content [10, 11]. Impulses stimulated by philosophical wisdom and ideals can act as catalysts for knowledge creation and utilization (Fig. 3).

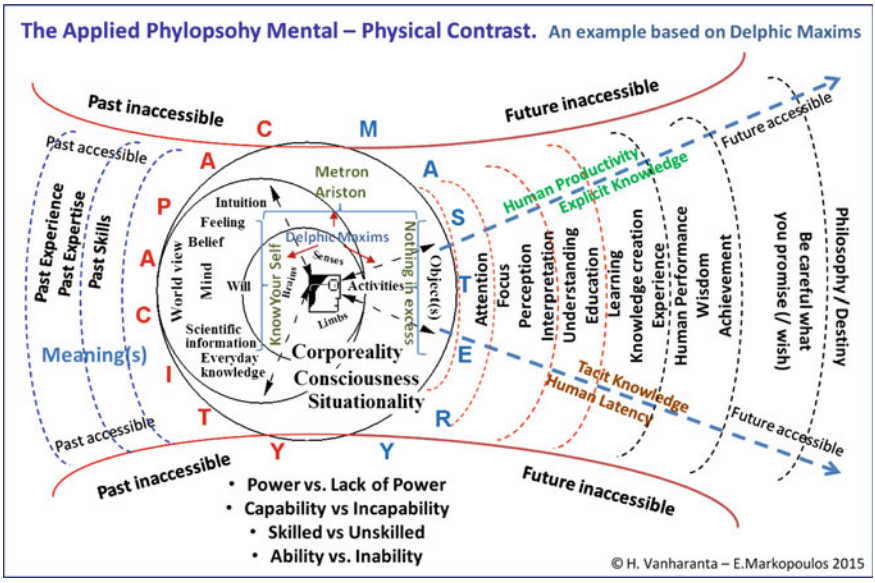


Fig. 3 The applied philosophy mental—physical contrast

11 The Circles of Mind Metaphor

For someone to understand and apply the Delphic maxims, it is important to understand first him/her self, having 'Gnothiseauton,' the Delphic Maxim for self awareness. The idea of the human being in a specific situation as a totality (Holistic Concept of Man) [10] is not a sufficient metaphor alone in the management and leadership context. The metaphor lacks the new, current research findings on the unconscious part of the human brain and it is also too simple for further use for specific targets; however, it has the important situationality component describing the many connections in human life. Baars [15] has combined psychology with brain science and the old conception of the human mind to create a metaphor based on the workspace of the mind. The totality can be explained through the theater metaphor, where the self as an agent and observer behave as if on the stage. Close to the stage is the unconscious part of the brain (the audience), which is divided into four main areas: the motivational system, automatic systems, interpreting system, and memory system.

The spotlight controller, context, and theater director also belong to the totality in this metaphor. A combination of the Holistic Concept of Man and the theater metaphor of Baars led to a new and very practical metaphor, i.e., the Circles of Mind metaphor [16]. The Circles of Mind metaphor was also designed as a physical entity so the metaphor could be used for many different purposes (Fig. 4).

This has led to the idea of a brain-based system that contains the physical body, following the Cartesian mind-body relationships, i.e., as a thinking substance and an extended substance [17]. Res cogitans "a Thinking Substance" was evident,

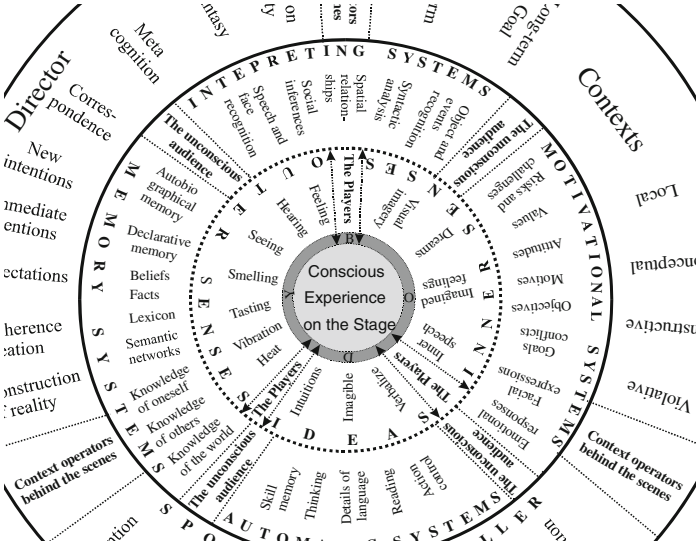


Fig. 4 The circles of mind metaphor [16]

consisting of the four main parts of the important brain processes affecting the conscious experience on stage. Res extensa, in turn, "an Extended Substance" (body) represents the other dimension of man, the physical dimension of the human being used on the stage. In this article, we bring different management and leadership objects (MOs) to the conscious experience on the stage, perceiving and understanding them from different angles and views and giving us the holistic view of their current and also the future coming stage.

Adding many of these personal, individual views and perceptions results in the collective understanding of these management and leadership objects, that is also an important challenge for individuals and organizations.

12 The Delphic Maxims and Circles of Mind

The Delphic Maxims give content and commands to the Res cogitans "Thinking Substance" and also to Res extensa "Extended Substance" (body), when these two different philosophical perspectives are put together. The three main maxims of ancient Hellenic wisdom can easily be part of the conscious experience on stage. The most famous of these maxims is 'Know thyself', focusing "Thinking Substance" on the person himself or herself. People must know themselves and this is the most important factor for managers and leaders too—that they really understand themselves better and better. In this thinking, the whole brain capacity should be used, i.e., all the four different sections of the unconscious part of the human brain, but also the conscious part created by the inner and outer senses of human being. Thus the situation or reality is understood and perceived in a holistic way. The Delphic Maxims also give commandments on how people should behave in different situations. "Nothing in excess" gives fundamental recommendations on how people should see both "Res cogitans" as well as "Res extensa" so that the whole entity operates well in a sustainable way. The third main construct "Be careful what you promise/wish" in the Delphi Maxims can be translated in many ways, but in management and leadership this construct gives an overall recommendation in the different situations people find themselves in.

13 The Socio-economic Impact of Applied Philosophy

Applied philosophy has a significant socio-economic impact, which is not easy to measure and evaluate quantitatively. It takes much more than business sense to identify the tremendous benefits that philosophy can offer the society and the economy, once effectively transformed into business management processes and practices. The great civilizations have contributed the most fundamental elements on which society can build today's and tomorrow's achievements. Anything made in the past had a reason, a cause, a practicality, a justification and a return not only

to the ones developing but also to the society and the economy as a whole. Such thinking is called Applied Philosophy. Humanity managed to evolve due to such philosophy-driven thinking for the progress and prosperity of the community not the individual, for common drivers and ideals. Shared value was placed highly on the expected outcomes of everything attempted to be designed and developed. Therefore, trying to understand the thinking of Hellenic civilization and others as well is very important in the development of sustainable business models that can stand the test of time. Advancements in the development of classification techniques, processes, and models not only utilize the dowry left to us by our ancestors, but also provide a deeper understanding on integrating this knowledge in today's society and economy. Utilizing such a magnificent wealth of knowledge heritage can only be achieved if the mindset of those analyzing it, turning it into business practices and applying it as well, is not far from the mindset of their ancestors, at it is impossible to see what those people had seen. Without such a mindset this knowledge, that could resolve so many problems of the modern economy and society, will not be utilized effectively, despite the current advancements in technology and communications. As long as today's managers value business more than society, not seeing that society is the economy, no classification of any such knowledge will be achieved effectively and rewardingly for all.

14 Areas of Further Research

Efforts on the classification of the existing knowledge in humanity through techniques, methods, and models that can turn this knowledge into applicable contributions to the modern economy and business management need to be continued. The Delphic Maxims are one set of knowledge that can generate significant business management values, but it is not the only one in the Hellenic philosophical contribution to the world. Further research will be done on specific Hellenic philosophers, whose life and work can be related to vertical business management needs and practices. The knowledge of Socrates, for example, can contribute enormously to understanding the requirements elicitation process which greatly inconveniences all projects in all sectors today. Insufficient requirements cause tremendous financial and operational costs for organizations not defining and handling them properly in the tendering, acquisition, and development stages of a project. Plato's knowledge can be classified for developing change management and re-engineering practices. Pericles' knowledge is highly suitable for project, program and product management, Aristotle's for organizational strategy, Thucydides for extroversion and internalization, Isocrates for teamwork management, Heraclitus for human resources management, Homer for design and production management, Herodotus for process, tactic and strategic management, Pythagoras for innovation management, Democritus for engineering management, and Solon for organizational leadership. In a similar way, knowledge from other significant civilizations, such as the Egyptian, Chinese, or Roman, can be categorized through the triadic knowledge representation

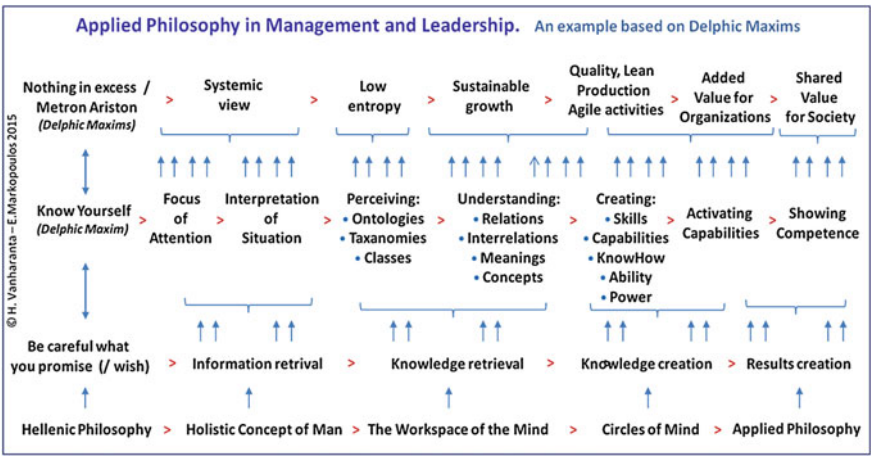


Fig. 5 Applied philosophy based knowledge management creation and utilization

approach (Ontologies, Taxonomies, Classes), and analyzed using the Circles of Mind, the Holistic Concept of the Man, and other knowledge creation models for added and shared value (Fig. 5).

15 Conclusions

A black hole in knowledge management is the definition of knowledge itself. What is knowledge and what is not is a very fuzzy concept. Knowledge can be generated by analyzing any information properly, giving results that can be applied either in theory, for further research or in practice. Knowledge cannot be produced in artificial environments. Knowledge is a living entity, growing organically in many forms and sources, and free to those able to seek it. Instead of investing in knowledge engineering efforts using artificial intelligence technologies, neuromanagement [18], cognitive sciences [19], and in all the state-of-the-art progress that people have significantly achieved over the years, it might be wiser to admit that knowledge, in a probably much more valuable form, can be found in the roots of past civilizations. With the proper classification techniques, methods, and models, the knowledge that can be extracted by analyzing history may surpass in value and return to the society and the economy the knowledge that is attempted to be generated through today's efforts to read people's minds [20]. Applied philosophy is not rocket science but simply common sense, but common sense doesn't seem to be common at all.

References

1. Markopoulos, E., Vanharanta, H.: Democratic culture paradigm for organizational management and leadership strategies—the company democracy model. In: Proceedings of the 5th International Conference on Applied Human Factors and Ergonomics AHFE 2014, Kraków, Poland, 19–23 July 2014 (2014)
2. Bowden, H.: Classical Athens and the Delphic Oracle: Divination and Democracy, p. 82. Cambridge University Press, Cambridge (2005)
3. Markopoulos, E.: The Kapodistrian principles for freedom through knowledge and education. In: Ioanis Kapodistrias Conference, 30 Oct 2013, Athens, Greece (2013)
4. Markopoulos, E., Vanharanta, H.: Company democracy model for development of shared value. In: 6th International Conference on Applied Human Factors and Ergonomics (AHFE), 26–30 July 2015, Las Vegas, USA (2015)
5. Oikonomides, A.N.: Records of "The commandments of the seven wise men" in the 3rd century B.C. Class. Bull. **63**(3), 67–76 (1987)
6. Nonaka, I., Takeuchi, H.: The Knowledge-Creating Company: How Japanese Companies Create the Dynamics of Innovation. Oxford University Press, New York (1995)
7. Bonacin, R., et al.: From ontology charts to class diagrams: semantic analysis aiding systems design. In: Proceedings of the 6th International Conference on Enterprise Information Systems, Porto, Portugal (2004)
8. Brachman, R.: A Structural Paradigm for Representing Knowledge. Bolt, Beranek, and Neumann Technical Report (3605) (1978)
9. Jackson, J.: Taxonomy's not just design, it's an art. Government Computer News, Washington, D.C., 2 Sept 2004 (2004)
10. Rauhala, L., Ihmiskäsitys, I.: The Conception of Human Being in Helping People. Gaudeamus, Helsinki (1986)
11. Vanharanta, H., Pihlanto, P., Chang, A.-M.: Strategic decision support systems in a hyperknowledge environment and the holistic concept of the decision maker. In: Walden, P., Brännback, M., Back, B., Vanharanta, H. (eds.) The Art and Science of Decision-Making, pp. 243–258. ÅboAkademi University Press, Turku (1996)
12. Vanharanta, H., Salminen, T.: Holistic interaction between the computer and the active human being. In: Jacko, J. (ed.) Human-Computer Interaction, Part I, HCII 2007. LNCS, vol. 4550, pp. 252–261. Springer, Heidelberg (2007)
13. Isomäki, H.K.: The prevailing conceptions of the human being in information systems development: systems designers' reflections [Online]. Electronic dissertation, Acta Universitatis Tamperensis 188 (2002)
14. Hakula, J.: The Purola model and the holistic concept of man metaphor as bases for the networked view of decision making in eHealth and eWelfare. Finnish J. eHealth Welfare FinJeHeW **1**(2), 107–117 (2009)
15. Baars, B.J.: In the Theater of Consciousness the Workplace of the Mind. Oxford University Press, p. 193 (1997)
16. Vanharanta, H.: Circles of mind. Identity and diversity in organizations—building bridges. In: Europe Programme XIth European Congress on Work and Organizational Psychology 14–17 May 2003, Lisbon, Portugal (2003)
17. Maslin, K.T.: An Introduction to the Philosophy of Mind (p. 313). Blackwell Publishers Inc., Malden (2001)
18. Satpathy, J.: Issues in neuro-management decision making. Opin.: Int. J. Bus. Manag. **2**(2) (2012)
19. Mischel, T.: Cognitive Development and Epistemology. Academic Press (2013)
20. Piccinini, G.: The first computational theory of mind and brain: a close look at McCulloch and Pitts's 'Logical calculus of ideas immanent in nervous activity'. Synthese **141**(2), 175–215 (2004)

Commitment and Motivation in Professional Organization

Johanna Koskialho, Jarno Einolander and Hannu Vanharanta

Abstract Personnel is vital for the companies and the performance in organizations is based on competence of personnel. Motivation and commitment are critical preconditions for organizational success. The study focuses on evaluating commitment and motivation levels of experts. The aim was to discover the main exceptions between the current status and the vision regarding commitment and motivation. The fluctuations of commitment and motivation levels were analyzed in terms of departments, gender, age and years of service. The survey was conducted by using Helix, an Evolute-based application, which was developed for measuring and evaluating the personnel commitment levels. This survey strongly emphasized the significance of affective commitment. In observing either the creative tensions or the product of creative tension and importance, all surfacing main categories fall under the affective commitment component.

Keywords Commitment · Motivation · Personnel · Creative tension

1 Introduction

Personnel is vital for the companies and the performance in organizations is based on competence of personnel. All organizations are, or should be, interested in achieving consistently high performance by getting the most of the personnel [1]. The best know-how, however, will be utilized only when the employees voluntarily provide their knowledge and competence for the use of organization. Motivation and commitment are critical preconditions for organizational success.

The likelihood of employees leaving the company is reduced by organizational commitment. Thus it is an important factor for retaining knowledge and strengthening

J. Koskialho (✉) · J. Einolander · H. Vanharanta
Tampere University of Technology, Pohjoisranta 11, 28101 Pori, Finland
e-mail: j.koskialho@gmail.com

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the sustainability of the competitive advantages of the organization [2]. There is a need for actual bottom-up evaluation due to evidence that aggregated employee opinions relate fairly strongly to important business outcomes, such as performance [3–5].

The levels of commitment and motivation have several effects on an individual and his behavior: a person who is committed and motivated reaches a higher performance level and better outcome. Regardless of the field the company operates in, productivity is based on commitment and motivation and successful operations are guaranteed by these factors. In competition, the determining difference between organizations depends on the level of commitment and the work contribution of the personnel [6–8].

The study focuses on evaluating commitment and motivation levels of the personnel of the Technical Department in a nuclear power plant. The aim was to discover the main differences between the current state and the vision for the future regarding commitment and motivation. The differences in commitment and motivation levels were analyzed in terms of departments, gender, age and years of service. The Technical Department consists of 150 employees and it operates in a multi-project environment. In addition to projects, various expertise tasks are performed. Most employees have either Bachelor's or Master's degree in Engineering.

2 Theoretical Background

2.1 Creative Tension

People tend to do only things which they believe they will manage [9]. Competence thinking, however, is based on a view that people are more capable than they think. Each organization has its unique characters describing the environment where employees perform their daily tasks. How a person performs his or her job depends on subjective perceptions of organization structures, culture, policies and atmosphere which form the individual understanding of the organization environment. The perceived differences between current competences and such competences that a person needs for efficient performance are critical. If these perceived differences change a person's beliefs also behavior can change since behavior is a reflex of beliefs. Thus a person can achieve a feeling of new and more extensive potential [10, 11].

Creative tension means the perceived difference between current and wanted competences. Creative tension is founded on the imbalance of current and hoped levels and personal vision. The remainder between vision and current stage acts as a boosting power, energy, towards one's vision. Creative tension can be unleashed only in two ways: either by moving the current level towards vision or by bringing vision towards the current level. Creative tension serves as an individual asset as a person strives towards vision. Creative tension has a central role in controlling a person's development. By defining creative tension, it is possible to identify certain competences and competence groups in which a person can develop [10, 11] (Fig. 1).

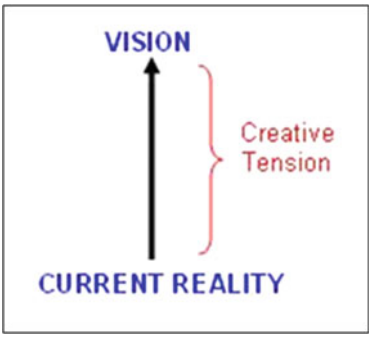


Fig. 1 Creative tension [12]

2.2 *Three Component Model of Commitment*

The three-component model has been the leading approach to commitment already for three decades. Meyer and Allen [13, 14] proposed the model where commitment was divided into affective, normative and continuous components (Fig. 2).

According to Meyer and Allen [13, 14] affective commitment means a person's emotional relationship, affection and identification to a certain organization when the normative component originates from a person's obligation to remain in the organization. The continuous component refers to all the costs that are caused by leaving the organization. Each of the components of commitment view commitment as a psychological condition which both characterizes a person's relationship with the organization and affects his or her decision to continue or end the organization membership. Despite the similarities, all psychological conditions of components of commitment differ from each other. A person with a strong affective commitment continues his or her organization membership because of the desire to do so. Employers, whose strongest component of commitment is the normative

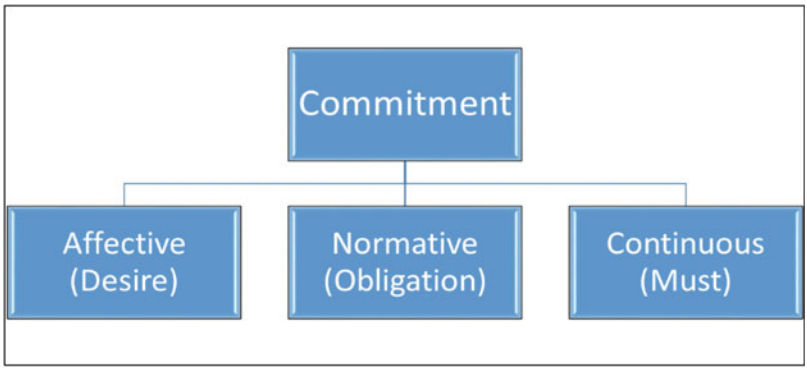


Fig. 2 Three component model of commitment [13, 14]

component, retain their membership in the organization because they feel they are supposed to do so; because of obligation. When the continuous component is the strongest, a person stays in the organization because he or she has to. It is possible to feel each of the three components of commitment simultaneously but with different degrees. A person can, for example, feel a strong need to retain the organization membership and the obligation to do so but at the same time feel no desire to do so. Because all the components can affect a person simultaneously but with different degrees, overall commitment can be viewed as a sum of the different psychological conditions of commitment [15].

According to Meyer and Allen [16] different backgrounds influence the development of each of the three components of commitment and they all have different effects on work behavior [17–19]. The theory of the three-component model of commitment has received a lot empirical support. Even though each component of commitment is separate and different from each other, they are also connected [20].

2.3 Motivation

Motivation is an internal schema, mood, that creates action. It also steers and generates our behavior affecting it either directly or subconsciously. It is a moving force and originally the word traces back to the Latin word "movere" which means to move. Later the meaning of the term has been expanded to mean also the system of factors that activate and steer behavior. Motives often refer to needs, desires, drives and intrinsic incentives, and also to rewards and punishments [1, 21, 22].

As a phenomenon, motivation is a complicated and complex concept. There is always a combination of several motivations underlying a specific behavior. Needs, desires, efforts, expectations and drives affect a person's motivation. Everything encouraging a forward motion and generating action is motivation [23–25].

Motivation can be divided into intrinsic and extrinsic motivation. Extrinsic motivation is based on rewards concerning actions that come from outside such as money and admiration and on the other hand on avoiding punishments. In intrinsic motivation the action itself is rewarding and a person can attend purely of joy and pleasure. Intrinsic motivation is also connected to positive feelings, thought and behavior. According to Deci [26] the satisfaction comes from the action itself, not from its results. Deci and his colleagues state that external rewards could even diminish the willingness to perform [27].

2.4 Helix-Instrument

The survey was conducted on Helix, based on Meyer and Allen's three-component commitment model. Helix, an Evolute-based application, was developed for measuring and evaluating the commitment levels of personnel [29]. The instrument

evaluates the differences between the current stages, goal stages and visions, and evaluates their importance to the personnel. Evolute has been developed as an Internet application, a platform for several test applications that can be developed and responded to globally. The evaluation process begins with self-evaluation. The aim is to map the personnel's own clear understanding of their professional level regarding a particular organizational resource [28]. Self-evaluation is conducted by examining their thoughts and feelings [29, 30].

The theoretical foundation for Evolute methodology rests on Senge's [12] view of creative tension. A realistic evaluation of the current situation is the starting point for all future visioning. Creative tension represents the strength behind the personal excellence. Continuous learning can be achieved through creating and maintaining the creative tension. Creative tension means the distance between target and current stages, and interaction between these stages forms creative tension. With the strength of an individual's collective creative tension, organizations can be moved to a new position [30].

3 Empirical Research and Sample

The purpose of the Helix-application is to provide a realistic comprehensive "bottom-up" view for the management of the commitment of their employees and factors affecting their engagement, including motivation. It provides important information for the management about their employees collectively, and provides guidance for the prioritizing of potential development activities.

The employees of the organization estimate the truth-value of each statement with regard to their own organization. All statements are evaluated as they are regarded at that moment in time, which gives the value of the current state of each feature and category-level variable. In addition, respondents specify the target state, meaning how they would like the situation represented by that statement to be in the future. Respondents also evaluated the importance of the claims.

The difference between the target state and current is creative tension [10], which means the willingness (or unwillingness) the respondents have to improve or change the matters presented in the statements. The value of the current state describes how respondents perceive and interpret the current situation, i.e. how committed, motivated or satisfied they are. The target state gives understanding of the value respondents give to features and categories. For example, if a high target state value is given to statements regarding job satisfaction it means that it is very highly valued compared to those features that have lower target states.

3.1 Sample

Fifty employees, which were selected randomly from the organization's research and development unit, were asked to participate in this research. All together this unit employs 150 people. Two respondents started the questionnaire evaluation, but left it unfinished. In the end, 44 employees completed the evaluation, which gives a response rate of 88 %, thus the sample is representative. Seventy-seven percent of these respondents were men and 23 % were women. The mean age of the respondents was 40.6 years old with a standard deviation of 10.6 years. All of the respondents in this sample were senior salaried staff, three of whom were in supervisory positions. Five respondents (11 %) decided not to answer the questions concerning demographics. The respondents had been in their current jobs for an average of 6.3 years (SD 6.6), in their organization for an average of 8.4 years (SD 8.5), and had an average of 17.5 years of work experience (SD 10.8).

3.2 Commitment Level

Generally, the personnel can be said to be fairly committed, the main focus being in the affective commitment, meaning the desire to remain in the organization (Fig. 3). Even though the level of commitment is fairly good, there are topics that the personnel wishes to be improved. The experiences of injustice and lack of respect surface on the top of the list. The feeling of injustice is highlighted in the salary and the personnel policies. It's evident that these kind of thoughts have negative effect on one's affective commitment. The desire for voluntary membership in the organization is diminished. At the same time the level of continuous commitment rises. The personnel remains in the organization in the absence of alternatives.

It is important to tackle the feelings of injustice and lack of respect. It is no solution that the personnel is told that they are being met equally and that they are being appreciated. If the experience of injustice has been manifested, it can be reduced only by greater openness. It is not easy to increase transparency if the organization is known to have salary discrepancies within the same work task. It is clear that transparency doesn't mean sharing all information. Nevertheless, it is important that the personnel knows the main principles, by which the salary is established and the criteria for awarding promotion or training possibilities. Also the appreciation must be evident in the practices of the organization. The simplest way to show this is to give the personnel constructive and supportive feedback.

Comparing the three components of the commitment, namely the affective, the normative and the continuous, one notices that the situation is best for the affective commitment, and worst for the continuous commitment. It is safe to say that the personnel finds itself in the employment relationship by its own will. They feel responsibility to remain as a member of their present organization. At the same

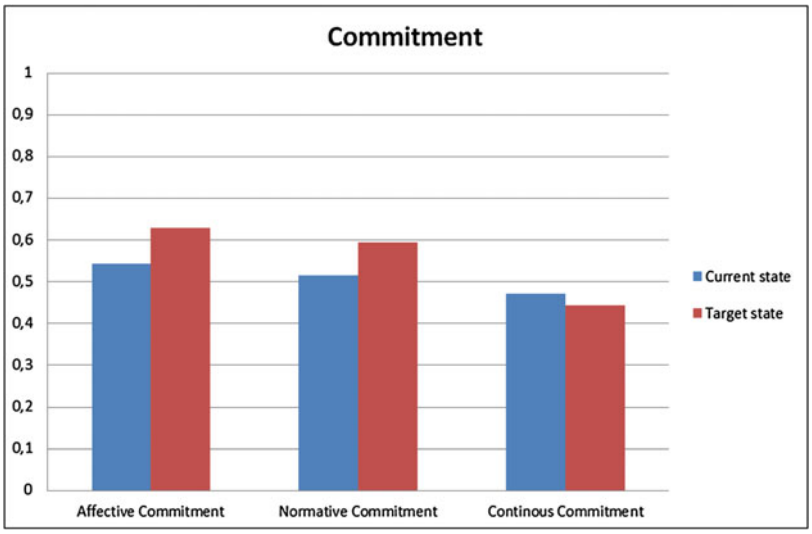


Fig. 3 Commitment level in the technical department (Evolutellc/Helix/Empirical Data)

time, they wish for more opportunities to change the employment. As well as they wish the possible employment change to be easier as they now experience it to be.

As one observes only the continuous commitment, the level of commitment appears to be quite weak. The situation, however, gets better as the other components of commitment are considered. The fact that a person hopes for more employment opportunities or the employment change to be easier, doesn't necessarily mean, that one wants to change employment. It also does not mean that one would change given the opportunity. Still, the fairly poor continuous commitment level should be noted seriously. It is a question of how to ensure the personnel's willingness to remain in their current employment in a situation where a number of alternatives are readily available and the changing of employment would not cause professional, economical or social problems. It is also about strengthening the affective commitment by supporting the factors attached to it and by removing the problems that surfaced during the study. As merely commitment was observed, it was noticed that the personnel was experiencing dissatisfaction and injustice regarding salaries and other benefits, education, improvement and career development. In addition, the personnel lacks feedback and feels neglected. It is important that the corporate governance thinks through how to tackle these issues.

3.3 Motivation Level

On a general level the personnel is motivated. Both intrinsic motivation and motivational aspect of work are on a high level as can be seen in the Fig. 4. There

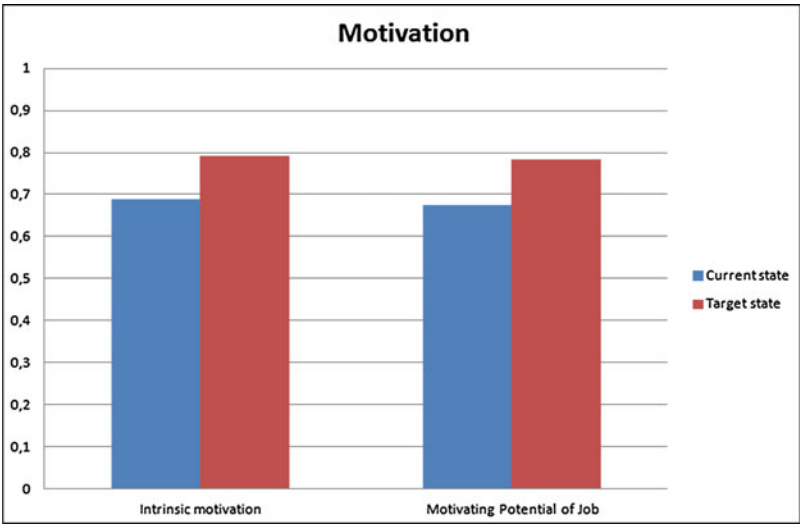


Fig. 4 Motivation level in the technical department (Evolutellc/Helix/Empirical Data)

are however issues surfacing from the answers that suggest that the personnel has a desire for improvements. The subcategory of "receiving feedback" under the motivational aspect of work had the strongest creative tension. The demand for more feedback surfaced strongly as the isolated claims were observed: The claim "I receive useful and constructive feedback, that helps me to improve my output"—never/sufficiently, had the strongest creative tension of all the claims. In addition to this claim receiving feedback surfaced also in context of claim no. 16: "I receive insufficient/sufficient feedback from my superior".

Some other strongly surfacing issues are connected to the intrinsic motivation; contentment towards work and succeeding in it. Work in itself is very important for the personnel. People want to feel good about their efforts and succeed in their work. The personnel wants their tasks to be interesting. They also hope to be able to have greater capacity to affect their own work.

A high level of contentment and succeeding in work are linked to the experience of feeling one's job to be meaningful, having responsibility for the results of work and understanding the results. The autonomy and variability of a task add to the work's meaningfulness. As the tasks are variable they are considered to be a part of a bigger picture and as tasks are deemed to be important, the personnel experiences it's work to meaningful. If given autonomy to perform the work, the personnel takes responsibility over the results of the work. Autonomy means the capacity to decide on work related issues. Understanding the results is linked to the given feedback. If a person doesn't get feedback, he/she doesn't necessarily possess the understanding whether the task has been successfully performed, thus the information of the results of one's work is not given.

It is very important to ensure that positive and performance enhancing feedback is given sufficiently. The superiors are to more actively contact their subordinates and discuss with them about their challenges and successes. The positive feedback adds to one's understanding about one's know how, competence. At the same time it is possible to explain the meaning of the task and how the performed tasks are related to other tasks. This will put more weight on the importance and the meaningfulness of a task. The autonomy can be increased by giving the personnel means to affect the way the wanted result is achieved.

As the level of commitment of different age personnel is observed, the differences are small. It appears that all of the components of commitment increases with age, being highest in the age group 40–50. This can be explained by many factors. Advancing in a career brings along more pleasing tasks thus resulting stronger affective commitment. By a higher age, changing employment might get harder because of the family relations: children go to school and a home has been acquired. According to the results of this study there is no evidence of differences in the motivation at different ages. Regardless of age the estimates of present state motivation level were practically the same as the level aimed at.

It can be observed of both affective and normative commitment, that those who have been in the organization for over 20 years have estimated both the present state level and the target level, highest. Also for the continuous commitment, the length of the membership in the organization raised both the present state and the target levels, but they peaked with those who had been in the organization for 11–20 years. The same age group estimated the present state levels of both intrinsic motivation and motivational aspect of work the highest. However, the creative tensions were highest for those who had been in the organization for 0–5 years.

Based on different kind of divisions, the differences of levels of both commitment and motivation were fairly small. According to this study, the gender has no effect on the commitment or motivation level of the personnel. The person's age and career length adds both the affective and normative commitments a little. The person's age does not affect motivation but the career length does. The motivation is at highest level for those who have been in the organization for 11–20 years.

4 Conclusions

This survey strongly emphasized the significance of affective commitment. In observing either the creative tensions or the product of creative tension and importance, all surfacing main categories fall under the affective commitment component. The job's motivation potential and particularly the intrinsic motivation were highlighted in analysis where creative tension was combined with estimated importance. On the other hand, the HR practices, observation of justice and fairness, and support of the organization were the main categories where the negative creative tensions were the highest, suggesting the greatest difference between the vision and the current status.

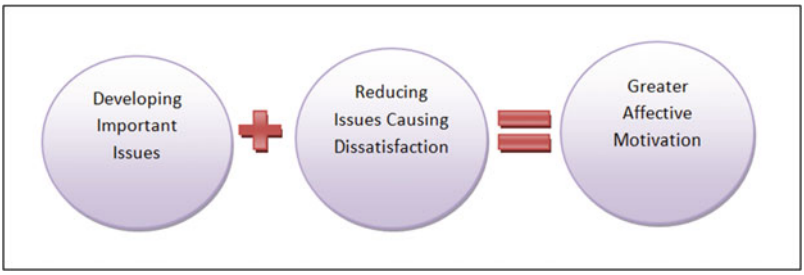


Fig. 5 Means to strengthen affective commitment

Affective commitment component has the most positive effect on person's motivation. Thus, strengthening this component is particularly important. However, being able to strengthen affective component one needs to understand how this can be done. As shown in Fig. 5, two means can be used.

In order to develop affective commitment motivation and especially intrinsic motivation is vital. The development of intrinsic motivation also has a positive effect on affective commitment. Thus, the most important development targets should be those issues which have the strongest effects on intrinsic motivation.

The information gathered using the application can be used to see the type of commitment the employees have and whether the employees feel engaged in their work, their work setting and organization. This sort of information can be argued to be very important and helpful for management when assessing employee feelings and motivation both currently and also in the future.

By using a new type of personnel survey as a decision-support system, it is easy for management to collect employee opinions widely and effectively. Using the survey instrument, management can acquire a shortlist of the most important HR practices that are likely to have the highest impact on engagement and commitment. However, such instruments can only give rough guidelines for the matter in hand because of the differences in people, cultures, and the constantly changing environment. Nevertheless, they provide considerable evidence about employees' feelings and information to support management decision-making. Therefore, managers and leaders should actively use this valuable information for improving decisions, and take full advantage of its potential.

References

1. Armstrong, M.: A Handbook of Human Resources Management. British Library Cataloguing in Publication Data. 251 (2006)
2. García-Almeida, D.J., Fernández-Monroy, M., De Saá-Pérez, P.: Dimensions of employee satisfaction as determinants of organizational commitment in the hotel industry. Hum. Factors Ergon. Manuf. Serv. Indus. **25**(2), 153–165 (2015)

3. Ostroff, C.: The relationship between satisfaction, attitudes, and performance: an organizational level analysis. J. Appl. Psychol. **77**(6), 963–974 (1992)
4. Schneider, B., Hanges, P.J., Smith, D.B., Salvaggio, A.N.: Which comes first: employee attitudes or organizational financial and market performance? J. Appl. Psychol. **88**(5), 836–851 (2003)
5. Vance, R.J.: Employee Engagement and Commitment. SHRM Foundation, Alexandria, VA (2006)
6. Huuhka, M.: Luovan asiantuntijaorganisaation johtaminen, pp. 144–145. Hämeenlinna, Kariston kirjapaino Oy (2010)
7. Hyppänen, R.: Esimiesosaaminen liiketoiminnan menestystekijänä. Edita Publishing Oy, Porvoo. 140 (2013)
8. Lampikoski, K. Panosta avainhenkilöihin - luo kilpailuetua sitouttamisstrategialla. Edita Prima Oy, Helsinki. 31 (2005)
9. Zwell, M.: Creating a Culture of Competence. Wiley, New York (2000)
10. Kantola, J., Vanharanta, H., Karwowski, W.: The Evolute System: A Co-Evolutionary Human Resource Development Methodology in International Encyclopedia of Human Factors and Ergonomics, pp. 275–276 (2005)
11. Liikamaa, K.: Piilevä tieto ja projektipäällikön kompetenssit. Tampere, Tampereen yliopistopaino Oy. 84 (2006)
12. Senge, P.: The Fifth Discipline. The Art & Practice of the Learning Organization. Doubleday, New York (1994)
13. Meyer, J., Allen, N.: Testing the "Side-bet theory" of organizational commitment: some methodological considerations. J. Appl. Psychol. **69**(3) (1984)
14. Meyer, J., Allen, N.: Commitment in the Workplace: Theory, Research and Application, p. 1997. Sage, Thousand Oaks (1997)
15. Cohen, A.: Commitment before and after: an evaluation and reconceptualization of organizational commitment. Hum. Resour. Manag. Rev. **17**, 336–338 (2007)
16. Meyer, J., Allen, N.: The measurement and antecedents of affective, continuance and normative commitment to the organization. J. Occup. Psychol. **63**, 3–4 (1990)
17. Ng, T., Feldman, D.: Affective organizational commitment and citizenship behavior: Linear and non-linear moderating effects of organizational tenure. J. Vocat. Behav. **79**, 529 (2011)
18. Wasti, A.: Commitment profiles: combinations of organizational commitment forms and job outcomes. J. Vocat. Behav. **67**, 291 (2005)
19. Aaltonen, T., Pajunen, H., Tuominen, K.: Syty ja sytytä: Valmentavan johtamisen filosofia. 3. painos. Hämeenlinna, Talentum Mecia Oy. 39 (2011)
20. Ruohotie, P.: Motivaatio ja työkäyttäytyminen. (3. painos) Tampere, Teollisuuden kustannus Oy. 9 (1991)
21. Kontiainen, J., Skyttä, A.: Esimiehen mielityö, prosessoivan johtamisen opas, Karisto, Kirjapaino Oy, Innotiimi Oy. 11 (2010)
22. Juuti, P.: Organisaatiokäyttäytyminen. Keuruu, Otavan Kirjapaino Oy. 38 (2006)
23. Ryan, R., Deci, E.: Intrinsic and extrinsic motivations: classic definitions and new directions. Contemp. Educ. Psychol. **25**, 69 (2000)
24. Deci, E.: Effects of externally mediated rewards on intrinsic motivation. J. Pers. Soc. Psychol. **18** (1971)
25. Liukkonen, J., Jaakkola, T., Kataja, P.: Taitolajina työ, pp. 28–29. Edita Prima Oy, Helsinki (2006)
26. Salmela-Aro, K., Nurmi, J.-N.: Mikä meitä liikuttaa, modernin motivaatiopsykologian perusteet. (2. painos), Keuruu, Otavan Kirjapaino Oy. 41 (2005)
27. Einolander, J.: Organizational commitment and engagement in two finnish energy sector organizations. Hum. Factors Ergon. Manuf. Serv. (2015)

28. Kantola, J.: Organizational Resource Management: Theories, Methodologies, and Applications, p. 138. CRC Press (2015)
29. Kantola, J., Vanharanta, H., Karwowski, W.: The Evolute System: A Co-Evolutionary Human Resource Development Methodology. Taylor & Francis Group, LLC (2006)
30. Kantola, J., Vanharanta, H., Laukkanen, I., Piirto, A.: Showing asymmetries in safety culture through proactive vision. Chem. Eng. Trans. **31** (2013)

Master's Students' Commitment and Engagement in Their Course Behavior

Jarno Einolander, Hannu Vanharanta and Ari Visa

Abstract Student commitment is a major concern for universities around the world. Research has indicated that students' psychological attachment to their university, in other words commitment, can be a major predictor of student retention, as well as affecting many other attitudes and types of behavior. This makes university commitment critical to university success. The present study seeks to find out whether there is a relation between students' grades and the degree of their engagement and commitment, using the Evolute approach. The research group in this study consisted of master's degree students studying in faculties of Business and Built Environment and Computing and Electrical Engineering. In the newly developed instrument, respondents assessed 124 unique statements regarding their current situation and their vision for the future. This score and its sub-scores are compared in relation to individual course grades.

Keywords Commitment · Engagement · Master students · Fuzzy logic · Human resource management · Leadership

1 Introduction

According to Ostroff [1], there are significant correlations between aggregated teachers' job satisfaction and organizational commitment and many indicators of school performance (student test scores, dropout rate, vandalism costs, student satisfaction, teacher turnover). The problem has been how to study this issue. Here

J. Einolander · H. Vanharanta
Tampere University of Technology (TUT), Industrial Management,
Pohjoisranta 11 A, P.O. Box 300, 28101 Pori, Finland
e-mail: jarno.einolander@student.tut.fi

A. Visa (✉)
Tampere University of Technology, Signal Processing, Korkeakoulunkatu 1,
P.O. Box 553, 33101 Tampere, Finland
e-mail: ari.visa@tut.fi

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one approach based on the Helix Student Application package and statistical methods is described. The following sections deal with engagement and commitment, the Helix Student Application, and the experiment itself.

2 Engagement and Commitment

Student engagement is a major concern for universities around the world. Research has shown that students' psychological attachment to their university, in other words, their commitment, can be a significant predictor of retention, as well as affecting many other attitudes and behaviors. Moreover, it is not only an important matter for universities, because it also has a direct link to the social, economic, and political growth of the country concerned.

Previous studies about student retention have concentrated on students' academic abilities to predict their retention. However, research has indicated that academic goals, institutional commitment, self-confidence, social support, and, for example, institutional selectivity and financial support, in addition to social involvement, have positive correlations with student retention. Students who cannot develop these factors are more prone to drop out. Previous studies have shown that the strongest factors seem to be related to academic skills, academic self-confidence, and academic goals [2]. However, studies have shown that academic performance can only account for half of the variance in the number of dropouts [3]. Additionally, earlier research has shown that students who are committed to a specific university are more likely to graduate than those who have the goal of graduating but feel no commitment to any specific educational institution.

According to Tinto [4], students are more likely to stay and graduate in a setting (1) that expects them to succeed, (2) that provides academic, social, and personal support, (3) that provides frequent and early feedback about their performance as they are trying to learn and persist, (4) that involves them as valued members of the institution (e.g. frequent and quality interaction with staff and other students), and (5) most importantly, students are more likely to persist and graduate in settings that foster learning.

Also, an important factor concerning student commitment is the level of motivation toward their studies. Motivation has been shown to have a positive influence on students' academic performance, study strategy, adjustment, and well-being. It has been reported in primary, secondary, and college education to influence academic performance through study effort [5].

Students can have different types of motivation (i.e. intrinsic and extrinsic). Intrinsic motivation is when students express interest in and inner acceptance of the value or utility of their studies and think the tasks are important because they enable high-quality learning and creativity [6]. Nevertheless, since many tasks students have to do in order to achieve their degree are not inherently interesting or

enjoyable, teachers have to be able to promote more active and volitional (versus passive and controlling) forms of extrinsic motivation [6]. Understanding these different types of motivation and what promotes them is a significant issue for universities in order to create a supportive and commitment-enhancing responsive environment. Therefore, universities need effective measures to evaluate student commitment and engagement.

3 Helix Student Application

Probably the two leading models of student persistence and retention are Tinto's [7, 8] Student Integration Model and Bean's [9] Student Attrition Model. Both of these models are based on the idea that commitment is a main factor in explaining persistence in educational institutes. According to Tinto [7], persistence occurs when a student successfully integrates into the institution academically and socially. Students' background characteristics (family background, individual attributes, and previous education experiences) influence their initial levels of goal commitment and initial commitment to their educational institute. These commitments influence their academic integration. Goals and institutional commitment are also influenced by peer group and faculty interactions, and out-of-classroom factors, which affect social integration [10].

Bean's Student Attrition Model [9, 11] regards student withdrawal as being comparable to employee turnover. He defined student attrition as the cessation of individual membership in a particular higher educational institute. Bean argued that students stay in their places of study for similar reasons to employees in organizations. Many studies regarding the Student Attrition Model largely support the presumed roles of organizational variables, personal variables, and environmental variables in shaping both attitudes and intents.

The evaluation method utilized in this study uses an Internet-based application environment called Evolute that supports different ontology-based applications [12, 13]. The Evolute approach is a modular process involving individuals and stakeholders where their perception and understanding of organizational resources are sought and collected with the help of statements. The Evolute system [14] computes and visualizes the meaning of the knowledge input collected from stakeholders. The basic idea for the instrument came from our previous research [15]. We used variables from the Bean and Metzner [11, 16, 17] Student Attrition Model as a framework to build the ontology and the statements for the instrument. As a result, 15 concepts were identified along with 113 applicable statements or 'features' describing them in six main categories. University management can use the computed current and future state of the resources to make a development analysis at their educational institution. This analysis can be made for the whole target group or sub groups under study.

4 Case Study A

The first research study, case A, was carried out with 19 students from Tampere University of Technology who were participating in a course on organizational behavior and leadership. The main characteristics of the course were the following: (1) the course contained both theoretical and practical parts, (2) the lectures were 80 % compulsory, (3) the teacher motivated students to learn during the lectures, (4) the course contained several self-development and human growth exercises, (5) the students ran the Helix Student Application (HAS) during the course.

The results of these test runs are reported in the following three figures. After the examination, the student grades were compared with three different main categories of the commitment and engagement test results, i.e., the goal commitment, institutional commitment, and intent to stay features (Fig. 1).

The commitment and engagement test results show a high current rate in the 5 main categories and relatively low results with the Environmental as well as Participative Decision Making categories. The results show clearly how students feel about their possibilities to affect the external variables as well as the decision making inside the university. The figures also clearly illustrate the main areas where their own impact is possible and where they can make improvements (Fig. 2).

The detailed analysis also shows the areas where students can improve their commitment and engagement. It can be noted that each of the features, apart from External Factors, give a proactive vision of the current state. External Factors describe binding variables that are external to the study environment such as family obligations. Therefore, little creative tension in this feature can be expected. The highest current states in this case are Goal Commitment, Distributive Justice, and Satisfaction.

From Fig. 3 we can conclude that there is a large variation in terms of commitment and engagement. These test results show clearly how each person views his or her situation in the academic world. The results can be used for management and leadership purposes (Fig. 4).



Fig. 1 Current and future state analysis with the main commitment and engagement categories

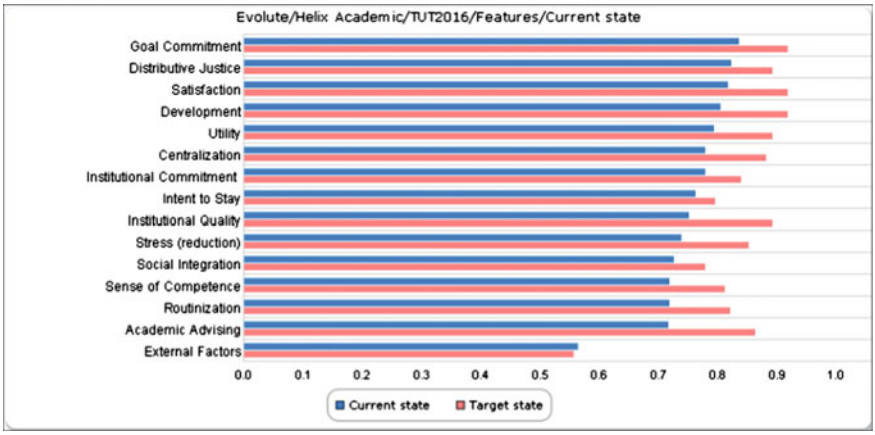


Fig. 2 Detailed analysis of the commitment and engagement features

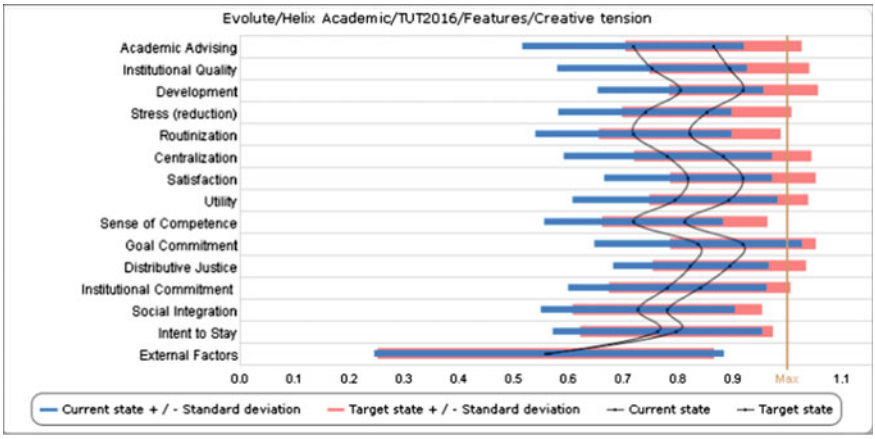


Fig. 3 Variation analysis of the commitment and engagement test runs

The degree of goal commitment and examination grades were analyzed after the course.

From this relationship, we can conclude that students' internal goal commitment correlates very well with the examination grades. The figure also shows very clearly how important it is for the students to pass the examination and often with high grades. The students who select this course are willing to learn organizational behavior and leadership and they were genuinely interested in the course (Fig. 5).

The test results show a larger variation compared with the previous test results. We can see that institutional commitment is not so important, but nevertheless the

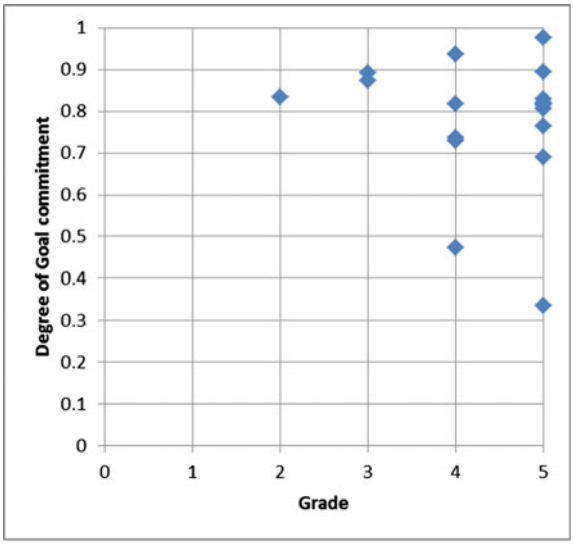


Fig. 4 The relationship between the degree of goal commitment and student's examination grades

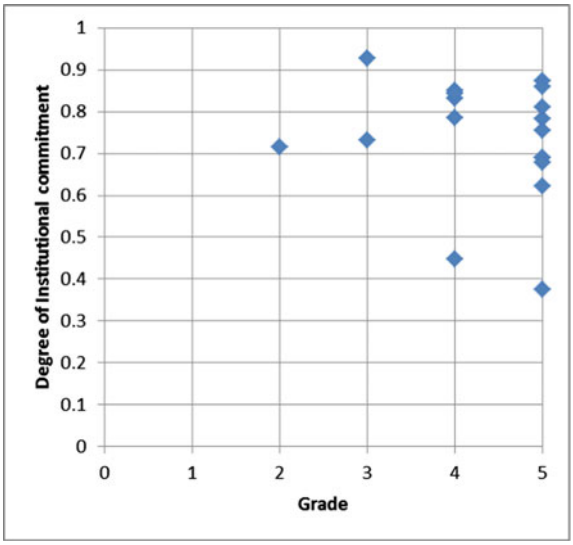


Fig. 5 Relationship between the degree of institutional commitment and examination grades

test results show a clear relationship between these two factors. The test results can be used in university management by creating an atmosphere where students better understand the institute itself and also the educational aspirations of the personnel, etc. (Fig. 6.)

The trend is the same as in the previous figures. Students are eager to stay at the institute and have expressed it relatively strongly.

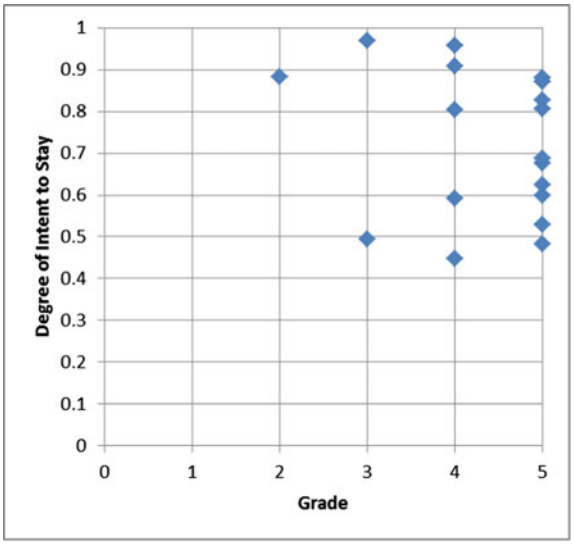


Fig. 6 Relationship between the intent to stay and examination grades

5 Case Study B

Research case study B was conducted with 50 students from Tampere University of Technology. The course on machine learning was selected based on three factors, namely (1) the course was a more demanding, theoretical course, (2) the students were international, and (3) there had usually been a great variation in learning results for this course. The students ran the Helix Student Application and the results achieved are reported below.

First, the complete profiles of the students were considered. Each profile was a 254 dimensional vector. The profiles were produced by the Helix Student Application. The students, in this case 42, were ranked with grades from zero to five. The profile of each student was considered. The Euclidean distance was calculated pairwise for each student, which is usually the basis for different clustering methods.

Table 1 A confusion matrix type presentation of the obtained grades and the number of grades of the closest profiles

Grade obtained	The number of grade obtained of the closest profile					
	0	1	2	3	4	5
0	1	3	1	0	1	0
1	0	2	2	0	4	0
2	0	0	1	1	2	4
3	0	0	0	2	1	4
4	0	0	0	0	6	3
5	0	0	0	0	0	5

Then the closest profiles were replaced with the corresponding grades. The results are shown in Table 1. Please note that in the ideal case there should be a diagonal matrix. The numbers on the diagonal are the same as the number of students with the respective grade. The total sum is the number of students minus one.

It is interesting to note that the grades four and five are more homogeneous than the others. It is also interesting to note that the students with grades two, three, and four have students with grade four as closest neighbors.

The aggregate results are shown in Fig. 7 and detailed results by topic in Fig. 8, while Fig. 1 shows the summary by category.

In Figs. 7, 8 and 9 the features have been sorted by the highest current state.

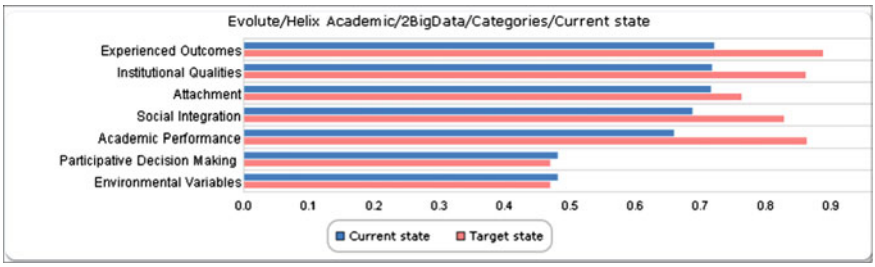


Fig. 7 Summary results by main category

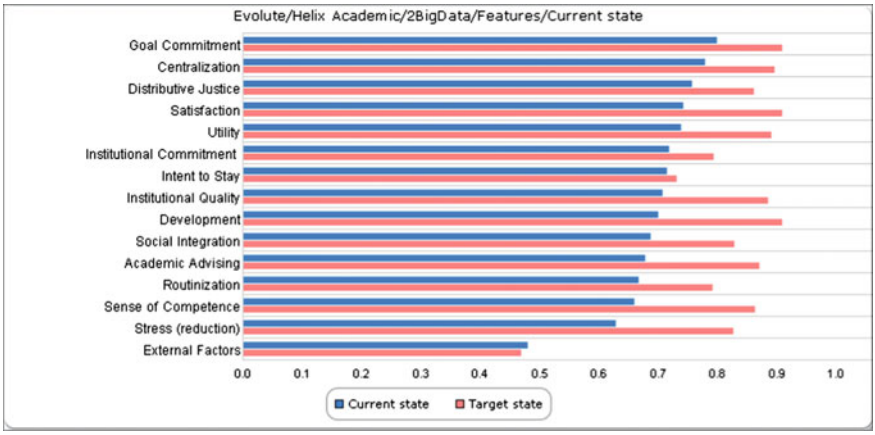


Fig. 8 Feature state results

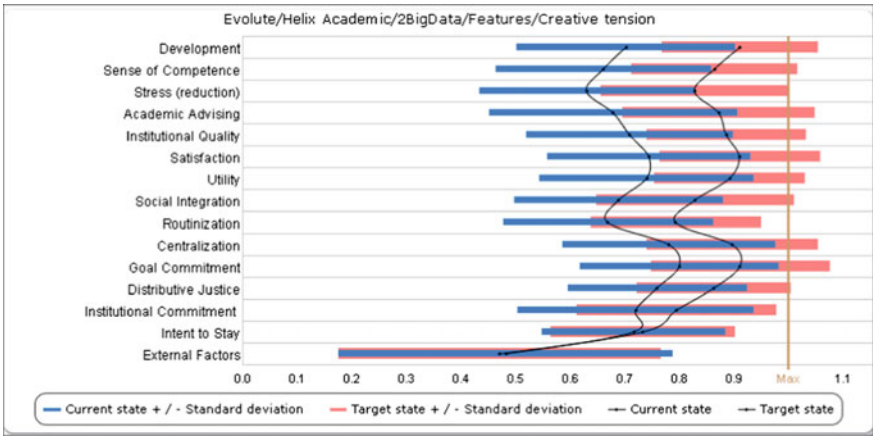


Fig. 9 Feature level results and their standard deviation

6 Conclusions

The interpretation of the results poses some challenges. We can see that there are certain similarities between students with a certain grade. However, this requires more in-depth analysis, especially the reasons why certain grades are more homogeneous than others.

The high dimensional space together with the different distance metrics play an important role. The role of different distance metrics should be studied. It also requires sensitivity analysis concerning the profiles.

In future, we need to gather more data on student commitment and motivation and their test results to see if there is a relationship, as expected.

References

1. Ostroff, C.: The relationship between satisfaction, attitudes, and performance: an organizational level analysis. J. Appl. Psychol. **77**(6), 963 (1992)
2. Lotkowski, V.A., Robbins, S.B., Noeth, R.J.: The Role of Academic and Non-Academic Factors in Improving College Retention. ACT Policy Report. American College Testing ACT Inc. (2004)
3. DeShields, O.W.J., Kara, A., Kaynak, E.: Determinants of business student satisfaction and retention in higher education: applying Herzberg's two-factor theory. Int. J. Educ. Manag. **19** (2), 128–139 (2005)
4. Tinto, V.: Promoting student retention through classroom practice. In: Enhancing Student Retention: Using International Policy and Practice, an International Conference Sponsored by the European Access Network and the Institute for Access Studies at Staffordshire University. Amsterdam, pp. 5–7 (2003)
5. Vansteenkiste, M., Zhou, M., Lens, W., Soenens, B.: Experiences of autonomy and control among Chinese learners: vitalizing or immobilizing? J. Educ. Psychol. (2005)

6. Ryan, R.M., Deci, E.L.: Intrinsic and extrinsic motivations: classic definitions and new directions. Contemp. Educ. Psychol. **25**, 54–67 (2000)
7. Tinto, V.: Dropout from higher education: a theoretical synthesis of recent research. Rev. Educ. Res. 89–125 (1975)
8. Tinto, V.: Leaving College: Rethinking the Causes and Cures of Student Attrition. University of Chicago Press (1987)
9. Bean, J.P.: Dropouts and turnover: the synthesis and test of a causal model of student attrition. Res. High. Educ. **12**(2), 155–187 (1980)
10. Grosset, J.M.: Patterns of integration, commitment, and student characteristics and retention among younger and older students. Res. High. Educ. **32**(2), 159–178 (1991)
11. Bean, J.P., Metzner, B.S.: A conceptual model of nontraditional undergraduate student attrition. Rev. Educ. Res. **55**(4), 485–540 (1985)
12. Kantola, J., Vanharanta, H., Karwowski, W.: The Evolute system: a co-evolutionary human resource development methodology. Int. Encycl. Hum. Factors Ergon. **3**, 2902–2908 (2006)
13. Kantola, J.: Ingenious Management, p. 568. Tampere University of Technology Publication (2005)
14. Kantola, J.: Organizational Resource Management: Theories, Methodologies, and Applications, 138 pp. CRC Press (2015)
15. Einolander, J., Vanharanta, H.: Degree of Commitment Among Students at a Technological University-Testing a New Research Instrument. Advances in Science, Technology, Higher Education and Society in the Conceptual Age: STHESCA, vol. 20, p. 60 (2014)
16. Bean, J.P., Metzner, B.S.: A conceptual model of nontraditional undergraduate student attrition. Rev. Educ. Res. **55**(4), 485–540 (1985)
17. Bean, J.P.: The Synthesis of a Theoretical Model of Student Attrition (1981)

Development of Students' Commitment over Time—Case Study from a Finnish University of Technology

Jarno Einolander and Hannu Vanharanta

Abstract Using a fuzzy logic-based application that utilizes linguistic scale values, we have evaluated commitment and engagement of five individual university students from Finland studying Industrial Management and Engineering from bachelor's to master's level. The data was gathered over one year and the students answered the application three times during different management courses. This research paper concentrates on analyzing three different commitment categories to see whether there has been change over time, as expected. Our assumption is that academic commitment and engagement toward studies tend to increase as studies progress and students approach graduation.

Keywords Commitment · Academic · Evaluation

1 Introduction

Student attrition and commitment is a major concern in higher education institutes around the world. It can be considered as a measure of the efficiency and quality of higher education institutions [1]. Student attrition can have both economic and social costs at the individual, institutional, and social [1, 2].

Higher education has many benefits, both to individuals and society. It has been found that higher education improves verbal, quantitative, communication, critical thinking, and moral reasoning skills (e.g., [3]). In addition, high education has been linked to outcomes such as lower unemployment rates, higher job satisfaction, lower reliance on social benefits and public assistance schemes, lower obesity rates, and higher reported levels of voting and volunteerism [4]. Therefore, student retention is not only an issue for universities but has a direct link to the social, economic, and political growth of a country, for which higher education provides strong foundations.

J. Einolander (✉) · H. Vanharanta
Tampere University of Technology, Pohjoisranta 11, 28100 Pori, Finland
e-mail: jarno.einolander@gmail.com

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In this research we analyze data gathered from five individual university students from Finland studying Industrial Management and Engineering from bachelor's level to master's. The data was gathered using a fuzzy logic-based application that utilizes linguistic scale values over 1 year. Over this period, students answered the Helix Academic application three times during different management courses. This study shows how various evaluated factors affecting commitment, such as academic goals, self-confidence, institutional commitment, as well as social involvement, have changed as their studies progress.

2 Evaluating Academic Commitment

According to Kantola [5], decisions regarding organizations should be based on real situational knowledge of the whole subject rather than knowledge of individual elements of the subject, and instead of "educated guesses," intuitive feelings, or information that represents only some aspects of an organizational resource. The lack of this kind of holism is a typical reason for the failure of many [5, 6]. Like in business organizations where holism is important in decision making, it is equally important in educational organizations such as universities.

The research instrument utilized in this study uses the ontology-based Evolute methodology [7, 8]. The Evolute approach follows a modular process where individuals and stakeholders are involved and their perceptions and understanding of organizational resources are sought and collected. In this case, the Evolute instrument assesses respondents regarding their current situation and the outlook for the future about engagement with their studies and their educational institute, and the sources of this commitment.

The developed ontology-based instrument contains 124 statements that assess students by self-evaluation using an Internet-based survey. The ontology and the statements were developed based on existing models of student persistence and retention, i.e., Tinto's [9] Student Integration Model and Bean's [10] Student Attrition Model. For a more thorough description of the instrument, see [11].

Once self-evaluation has been conducted, students and academic staff become more aware of possible development gaps and can base their objectives for improvement on concrete bottom-up results. Ontologies are perceived and evaluated in dynamic situations [5]. Indicators, i.e., statements are used to evaluate the perceived current state and envisioned future state. Figure 1 illustrates the assessment of one indicator in the Evolute system.

Both Tinto's [9] Student Integration Model and Bean's [10] Student Attrition Model models agree that commitment is a key factor in explaining persistence in educational institutes. According to Tinto [9], persistence occurs when a student successfully integrates into the institution academically and socially. In other words, attrition is caused by the lack of, or weak, student integration into the social and/or academic environment of the educational institute. A student's background characteristics (family background, individual attributes, and previous education

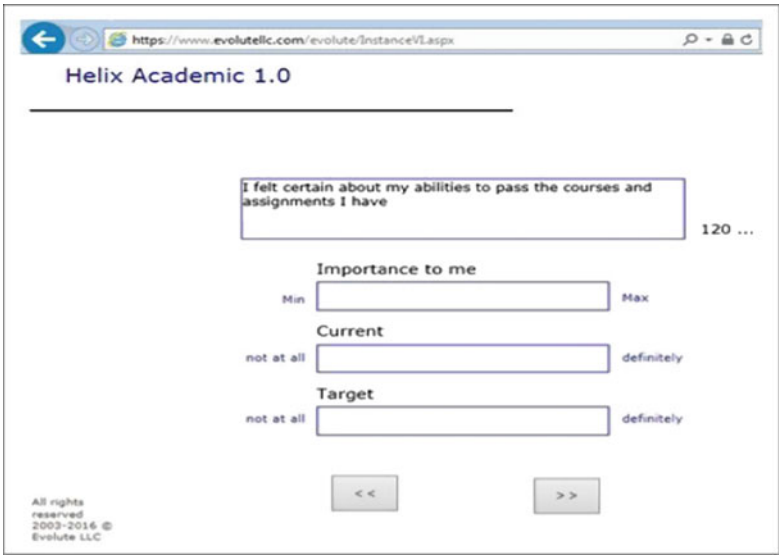


Fig. 1 Evaluation of an instance using Helix Academic

experiences) influence their initial level of goal commitment and initial commitment to their educational institute. These commitments have an influence on academic integration. Goals and institutional commitment are also influenced by peer group and faculty interactions, and out-of-classroom factors which contribute to social integration [12]. Habley [13] argued that one of the main factors affecting academic retention is the quality of interaction a student has with other people on campus. This increased integration, both academically and socially, leads to greater goal commitment and institutional commitment, which in turn leads to lower dropout rates and higher graduation rates. Based on Tinto's model, students who fail to successfully integrate academically or socially are likely to leave the educational institute. In his more recent paper, Tinto [14] identified five conditions that promote student persistence: expectations, support, feedback, involvement, and learning.

According to Tinto, students are more likely to persist and graduate in a setting (1) that expects them to succeed, (2) that provides academic, social, and personal support, (3) that provides frequent and early feedback on their performance as they are trying to learn and persist, (4) that involves them as valued members of the institution (e.g. frequent and quality interaction with staff and other students), and (5) most importantly, students are more likely to persist and graduate in settings that foster learning. Students who are actively involved in learning, i.e., who spend more time on a task, especially with others, are more likely to learn and, in turn, more likely to stay [14].

On the other hand, Bean's Student Attrition Model [10, 15] regards student withdrawal as being like employee turnover. He developed a model of student

attrition based on organizational commitment literature focusing on turnover in work organizations. He defined student attrition as the cessation of individual membership in a particular higher educational institute. He argued that students stay in their higher educational institutes for similar reasons to employees in organizations, hence it is analogous to organizational commitment. The results of many studies of the Student Attrition Model largely support the presumed roles of organizational variables, personal variables, and environmental variables in shaping both attitudes and intents.

Evolute computes the current and future degree of organizational resources so management can utilize this in their real situational management context [5]. In this case, the evaluated resources are related to factors that have a committing and engaging effect for students. The computing behind Evolute is based on soft computing methods in order to cope with imprecision and uncertainty embedded in natural language and human knowledge inputs [5]. Particularly, fuzzy sets and fuzzy logic are applied in the Evolute system [16, 17]. On a hands-on level, respondents are asked to assess the current state in terms of the statement, how they feel about things at that moment in their university. Also, an evaluation is made of the desired target or future state, how they want or envisage the situation in the future. This evaluation results in the creation of a proactive vision, i.e., the gap between the current reality and future vision. Objectively speaking, the gap between personal vision and current reality forms an individual's creative tension [18], which identifies the possible fields of improvement and intervention. Figure 2 shows an example of complete results computed by the Evolute system from the Helix Academic application. In the next section, the research setting is discussed and data analyzed.

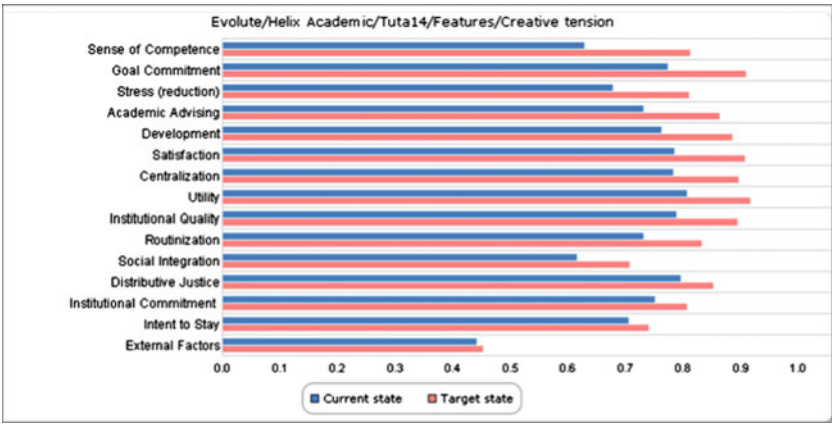


Fig. 2 Sample of computed results from Helix Academic application

2.1 Sample and Data Analysis

The study sample consists of five individual students from Tampere University of Technology, Pori unit, in Finland. The students in question were studying Industrial Management and Engineering from bachelor's level to master's. The data was gathered over 1 year during two semesters, i.e., fall 2014 and spring 2015. The students were in their second year of a three-year program. They responded to the Helix Academic application's statements three times during different management courses.

In this study, three commitment categories were extracted from the whole instrument. The selected categories were Goal Commitment (A), Institutional Commitment (B), and Intent to Stay (C). Goal Commitment is used to evaluate feelings that students have of taking responsibility for their own studies and committing to the goal of graduation. Institutional Commitment, on the other hand, is used to assess students' emotional commitment and attachment to their particular university. Lastly, Intent to Stay is meant to assess students' intent to graduate from the particular university they are currently studying at. The results for A, B, and C are presented and discussed below. The lower bars in the charts describe the current state and upper bars the target state concerning the result of the study.

A. Goal Commitment Test Results. Six statements are used to assess Goal Commitment. The scale for answering is displayed after the statement.

1. I complete my assignments and projects on time: not at all–definitely
2. I feel a high degree of personal responsibility for my studies: not at all–considerable
3. It's hard for me to care much whether or not I complete my studies: agree–disagree
4. I am motivated to give 100 % to my studies: not at all–definitely
5. I expect to graduate with good grades: not at all–definitely
6. I have a clear strategy of how I will complete my studies: not at all–definitely (Fig. 3)

From the results we can see that each time the collective result moves slightly higher, in both current and target state. This result, as expected, shows that the students feel very strongly committed to their studies. It is expected because they are mature students who already have a previous degree and are motivated to advance their educational status. Individual results in this category for the current state in the 1st evaluation range from 0.73…1, in the 2nd evaluation from 0.78…1, and in the 3rd evaluation from 0.8…1. For the target state, the individual results in the 1st evaluation range from 0.82…1, in the 2nd evaluation from 0.86…1, and in the 3rd evaluation from 1…1.

B. Institutional Commitment Test Results. Thirteen statements are used to assess Institutional Commitment:

1. I value the education I am receiving here: not at all–completely
2. I enjoy discussing my university with people outside it: not at all–considerably

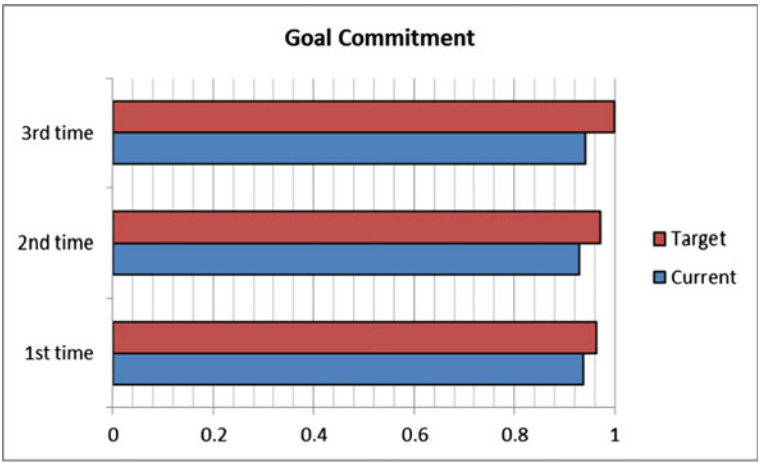


Fig. 3 Results from the Goal Commitment category

3. I am proud to tell others where I study: not at all–considerably
4. When someone praises my university, it feels like a personal compliment: not at all–completely
5. This university has a great deal of personal meaning for me: not at all–considerable
6. I do not feel a strong sense of attachment to this university: agree–disagree
7. I think that I could easily become as attached to another university as I am to this one: agree–disagree
8. Deciding to study in this university was a definite mistake on my part: agree–disagree
9. It would take very little change in my present circumstances to make me leave this university: agree–disagree
10. I feel no obligation to remain and study with this particular university until I graduate: agree–disagree
11. I am committed to graduating from this university: not at all–completely
12. I have invested a lot in studying at this university: not at all–considerably
13. Obtaining a degree from this university will certainly help me in the future: disagree–agree (Fig. 4)

When analyzing the results from Institutional Commitment, they give very similar results to those of Goal Commitment. The students have had a high level of commitment to their university throughout their studies. Individual results in this category for the current state in the 1st evaluation range from 0.68…1, in the 2nd evaluation from 0.73…1, and in the 3rd evaluation from 0.76…1. For the target state, the individual results in the 1st evaluation from 0.72…1, in the 2nd evaluation range from 0.73…1, and in the 3rd evaluation from 0.81…1.

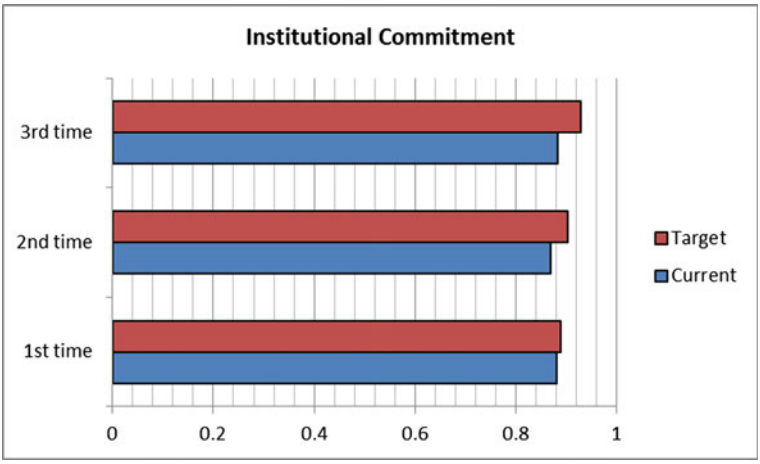


Fig. 4 Results from the Institutional Commitment category

C. Intent to Stay Test Results. Intent to Stay is assessed using six statements:

1. I am determined to graduate from this particular university: not at all–completely
2. Sometimes I feel like changing to another university: always–never
3. I have not thought seriously about studying anywhere else: disagree–agree
4. Leaving this university would require a considerable personal sacrifice: disagree–agree
5. Lack of alternative places to study keeps me at this university: completely–not at all
6. I have invested too much time, effort or money in this university to leave before I graduate: disagree–agree (Fig. 5)

The Intent to Stay category reveals slightly different results than the two previous categories. It seems that the degree of intent in this category has slightly decreased. However, it is still at a high level and should not be viewed as alarming. Individual results in this category for the current state in the 1st evaluation range from 0.51…1, in the 2nd evaluation from 0.50…1, and in the 3rd evaluation from 0.49…1. For the target state, the individual results in the 1st evaluation range from 0.48…1, in the 2nd evaluation from 0.50…1, and in the 3rd evaluation from 0.44…1.

Analyzing the lower level Intent to Stay test results with the previous Goal Commitment and Institutional Commitment test results, we can conclude that we need more detailed analysis through the statements used. By focusing attention on the biggest changes on the statement level, more information can be gathered to be used for decision support and decision making.

One other reason to be considered is that, during even a short period of time, studies can be very demanding as well as complex and the intent to stay may

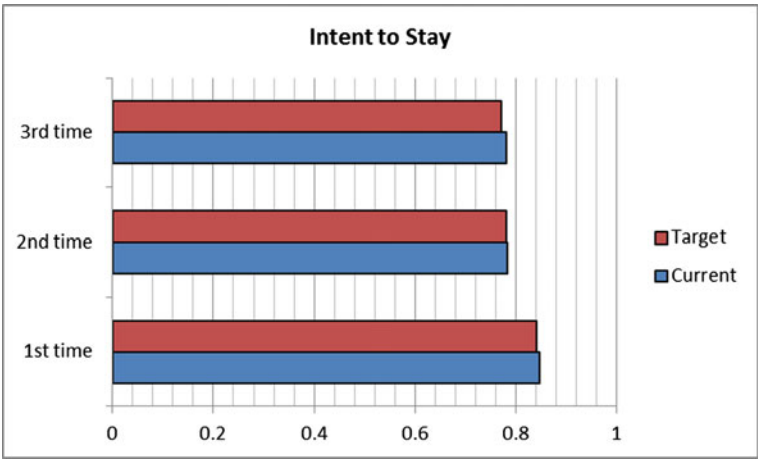


Fig. 5 Results from Intent to Stay category

decrease considerably, especially with our mature students, who are situationally connected to their families, children's hobbies, and school as well as to their regular job. These new test results, if they are valid in a larger sampling group than we have now, may lead to interesting new research.

3 Conclusions

The study results support our view concerning this group that their commitment is at a high level and that they are committed to graduating from their current university.

The assessments were able to show the collective feeling among the respondents, i.e., how they felt at that precise moment in time. Although the results cannot be generalized in any way because of the very small research group, it gives a good indication of how they feel regarding their commitment. Using collective information from a larger research group can be used to form effective strategies to support students and to help them become more engaged and integrated into academic life, leading to the prevention of dropout problems.

Currently, the instrument described in this study has been used to evaluate commitment and engagement from students who are at various stages in their studies at five different university units in three different countries, i.e., Finland, South Korea, and Poland. Currently, the empirical research covers over 250 academic responses from students of various nationalities. These studies have provided us with a lot of information about the functionality, usability, and efficiency of the Co-Evolute method.

References

1. Martinez, A., Borjas, M., Herrera, M., Valencia, J.: Relationship between measures of academic quality and undergraduate student attrition: the case of higher education institutions in the Colombian Caribbean region. High. Educ. Res. Dev. **2015**, 1192–1206 (2015)
2. Tinto, V.: Defining dropout: a matter of perspective. New Dir. Inst. Res. **1982**(36), 3–15 (1982)
3. Pascarella, E.T., Terenzini, P.T.: How College Affects Students: A Third Decade of Research, vol. 2. Jossey-Bass, San Francisco (2005)
4. Baum, S., Ma, J., Payea, K.: Education pays 2010: the benefits of higher education for individuals and society. http://www.thecollegesolution.com/wp-content/uploads/2010/09/Education_Pays_2010.pdf (2010)
5. Kantola, J.: Organizational Resource Management: Theories, Methodologies, and Applications. CRC Press (2015)
6. Jackson, M.: Systems Thinking—Creative Holism for Managers, 378 p. Wiley, Chichester
7. Kantola, J.: Ingenious Management. Tampere University of Technology Publication. 568 (2005)
8. Kantola, J., Vanharanta, H., Karwowski, W.: The evolute system: a co-evolutionary human resource development methodology. Int. Encycl. Hum. Factors Ergon. **3**, 2902–2908 (2006)
9. Tinto, V.: Dropout from higher education: a theoretical synthesis of recent research. Rev. Educ. Res. 89–125 (1975)
10. Bean, J.P.: Dropouts and turnover: the synthesis and test of a causal model of student attrition. Res. High. Educ. **12**, 155–187 (1980)
11. Einolander, J., Vanharanta, H.: Assessment of student retention using the evolute approach, an overview. Proc. Manuf. **3**, 581–586 (2015)
12. Grosset, J.M.: Patterns of integration, commitment, and student characteristics and retention among younger and older students. Res. High. Educ. **32**, 159–178 (1991)
13. Habley, W.R.: The Status of Academic Advising: Findings from the ACT Sixth National Survey. National Academic Advising Association (2004)
14. Tinto, V.: Promoting student retention through classroom practice. In: Enhancing Student Retention: Using International Policy and Practice, an International Conference Sponsored by the European Access Network and the Institute for Access Studies at Staffordshire University, Amsterdam, pp. 5–7 (2003)
15. Bean, J.P., Metzner, B.S.: A conceptual model of nontraditional undergraduate student attrition. Rev. Educ. Res. **55**, 485–540 (1985)
16. Zadeh, L.: Fuzzy sets. Inf. Control **8**(3), 338–353 (1965)
17. Zadeh, L.: Outline of a new approach to the analysis of complex systems and decision processes. IEEE Trans. Syst. Man Cybern. **1**(1), 28–44 (1973)
18. Senge, P.: The Fifth Discipline: The Art and Practice of the Learning Organization. Doubleday/Currency, New York (1990)

Part III
Human Resource Management

Skills and Human Engineering Issues at Task Design

Olivier Chator and Jean-Marc Salotti

Abstract The risk of inadequate critical task design is recognized by NASA as an important issue with potential risk to human health and performance in space. We propose an information system based on skills management to adapt the tasks and procedures time to time, after each new experiment in training or real operations.

Keywords Skills · Competencies · Critical task design

1 Introduction

In the domain of human spaceflight, it is often required to build complex systems that astronauts will operate, for instance life support systems, communication systems, power systems, propulsion systems, etc. [1, 4, 8]. These systems are defined by functions and interfaces. In order to exploit them, astronauts must train and acquire specific knowledge and skills:

- General knowledge of the domain.
- Knowledge of the functions of the systems.
- Knowledge and knowhow of actions and procedures associated with the proposed interfaces and understanding of their impact on the systems and the environment.

In addition to that, according to NASA, it is also required that astronauts must train to acquire behavioral competencies (stress management, communication skills, situational awareness, etc.) [3].

Once the tasks and the procedures are designed, two important problems are generally encountered:

O. Chator (✉) · J.-M. Salotti
IMS Laboratory, CNRS, Bordeaux INP, Bordeaux University, Bordeaux, France
e-mail: o.chator@gironde.fr

J.-M. Salotti
e-mail: jean-marc.salotti@ensc.fr

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- It is difficult to design the procedures accurately and exhaustively such that all situations are addressed (NASA TASK, [5]). Procedures have therefore to evolve time to time according to the experience acquired during training or space operation. But how to implement this evolution?
- Astronauts must train to acquire the necessary skills to exploit the systems in an efficient way and reduced risks [6, 7]. But how to characterize these skills?

These two problems are addressed in this paper. We propose the use of an information system based on skills management. In Sect. 2, a description of our system is proposed and in Sect. 3, an example is provided.

2 Information System

Experts in the design of critical tasks and procedures propose several recommendations [1]:

- Evaluate all current and future procedures for their usability and executability
- Simplify the procedures by using more graphics, less wording, and more intuitive
- Develop the procedures to accommodate experts versus novice users and users from multi-cultural background
- Personalize the procedures according to the user profile (expert, novice, and so on)
- Decrease the need for the user to scroll through the procedures or to use multiple screens to view them

An important and difficult question is how to define the skills required for the use of the systems. We propose to make an important assumption: in first approximation, a technical skill can be defined by the ability to operate a list of elementary tasks in a specific situation to solve a specific problem. As these tasks are described in details in the procedures manual provided to the astronauts, the definition of the skills is straightforward. However, it is difficult to determine a priori the complexity of a given task and the relevance of the ability to operate it. These difficulties usually are encountered and better understood time to time, after each new experiment in training or real operations. We propose to call the ability to operate an elementary task an “elementary competency”. A technical skill is then defined by a list of weighted elementary competencies (EC). This list may evolve time to time as well as the weights associated to each elementary competency. In order to comply with this flexibility constraint, we propose to use a multi-agent system (Fig. 1), where agents are “autonomous skill agents” (ASA). This approach is based on a previous proposition that has been carried out in the Gironde region to share the skills of actors working together to implement a sustainable development project [2].

For the sake of simplicity, it is assumed that a skill is a sum of elementary competencies (ECs), which are required to achieve a task. It is assumed that a skill

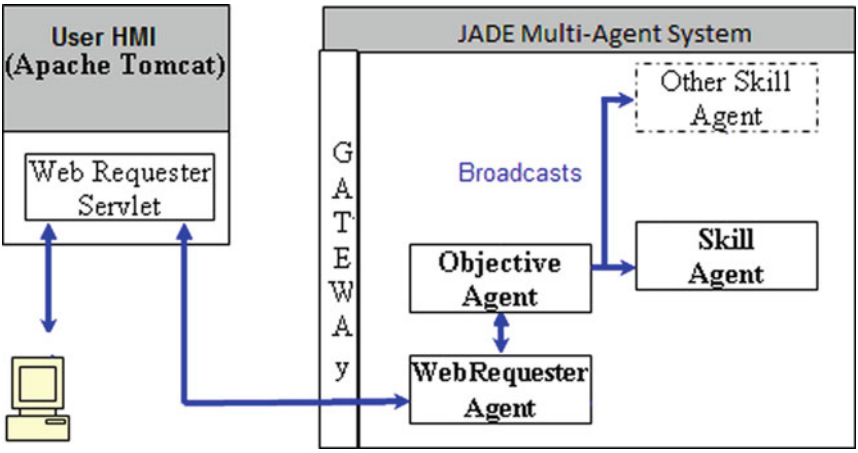


Fig. 1 Flow exchanges into the multi-agent system

is unique and can be implemented as an agent in a multi-agent system (MAS). A skill agent is cognitive, non-conversational and non-dialogic [2, 10]. It has 3 "ages" (childhood, teenage, and mature) corresponding to different adaptive behaviours. Each EC is assessed after each astronaut operation and contributes to the learning abilities. The skill agent environment is defined by indirect (through another technical agent) interactions with the users. It has:

Perception: It listens to information broadcasted by other agents or environmental evolutions, e.g., a new task starts.

Internal attributes: It is defined by a list of elementary competencies, a creation date, a domain(s) of activity, and a specific "age".

Action: It updates its behavioural rules and the weight of elementary competencies that define it.

The main concerns of the learning mechanism, for a skill agent, are actors' selection (identifying a human person, e.g. an astronaut, to implement a given task), adding links with other skill agents, and improving skills management. The link establishment decision is based on similarity studies, like common involvement into tasks over time. Behavioural rules' evolution is a consequence of those learning mechanisms. Currently, we consider that each ASA owns an auto-definition behaviour, considered as emergent, and viewed as a consequence of learning mechanisms (ECs list, links with other ASAs, and so on). For more information, see reference [2].

3 Example

We proposed to illustrate our method with an example. See Table 1. It is based on procedures found in the Shuttle Crew Operation Manual (SCOM) [9]. The objective of the task is described in the first column. In NASA SCOM, the task is split into

Table 1 TASK illustration: communication loss [9, p. 887]

Main task	Skill agents	Action marker elementary tasks/competencies
Problem to be solved: ICOM lost		
Select the backup audio terminal unit (ATU)	ICOM1 Agent1	Select the backup audio terminal unit (ATU) via the POSITIONS control switch
	ICOM2 Agent 2	if ICOM1 doesn't regain ICOM, the alternate audio central control unit is selected via panel
	ICOM3 Agent3	If ICOM1 and ICOM2 do not regain ICOM, a different ATU, crew communications umbilical (CCU) connection, or headset/handheld microphone may be required to regain ICOM
Problem to be solved: UHF lost		
Verify UHF squelch system	UHF1 Agent 4	Turn off the system to ensure good signal reception
	UHF2 Agent 5	Select an alternate ACCU power source
	UHF3 Agent 6	Three frequencies are available (259.7, 296.8, and GUARD). All should be tried. GUARD is an international UHF frequency that is only used in emergencies
Verify antenna	UHF4 Agent 7	Since the UHF antenna is located on the orbiter's belly, a roll to heads up is performed to ensure optimum antenna gain
Verify power amplifier	UHF5 Agent 8	Finally, the UHF power amplifier is turned off. If successful, a low power transmit mode will be available.

several sub-tasks, which are given in the second column. As these sub-tasks typically correspond to the level of our skill agents, we propose to define the skill agents with the same features.

In the third column, action markers can directly be used as elementary competencies. Importantly, in the preliminary definition of the procedures, some agents (e.g., basic skills) might not be seen as relevant, but after several simulations, it might become obvious that they should be included in the list. For instance, Agent 5 (select an alternate power source) might be added to the list of skills required to recover the ICOM lost. This problem illustrates the need for a flexible and dynamic system. In the proposed approach, when a new procedure is defined to solve a specific problem, skill agents may automatically suggest their inclusion in the list of required skills, depending on similarities that can be detected with other tasks [2].

4 Human Behaviour and Performance Competency Model

Human factor management has been identified by NASA as an important aspect for the preparation of long duration space flight missions [1]. It is formalized using a model of 8 behavioural skills [3]. This human behaviour and performance competency model puts the accent on the adaptability of skills according to the variations of environmental situations. The 8 skills are dealing with human factors: communication, conflict management, cross-culture, decision making and problem solving, leadership, situational awareness, self-care, teamwork and group living. Each of them is characterized by "competencies", and owns what is called "behavioural markers" (BM). Those BMs are used for evaluation purposes while training, and sometimes during astronauts' selection process. Noticeably, during simulations, training astronauts to these skills is carried out in parallel of the technical training. We propose to add behavioral skills in our information system. As NASA already provided a decomposition of the global skills into a list of skills and a list of markers for each skill, this adding is straightforward. See Table 2 for an example with the situational awareness skill. Once again, it is difficult to determine the relevance of a particular skill for a given task. After simulations, it can be decided that a specific marker should be added or a weight should be increased or decreased.

Table 2 Human behaviour skills

Global skill	Skill agents	Behavioural marker elementary competencies
Situational awareness		
Maintenance of an accurate perception of the situation	SA1	Monitors people, systems and environment
	SA2	Monitors self and others for signs of stress, fatigue, complacency, and task saturation
	SA3	Reduces distractions while performing operational tasks
	SA4	Maintains awareness of the environment while focusing on a task or problem
	SA5	Maintains the required level of vigilance for low and high workloads
	SA6	Uses the two-person approach to execute critical tasks and procedures
Processing of information	SA7	Analyzes information to determine operational relevance
	SA8	Assesses impacts of actions, plans and decisions on others
	SA9	Anticipates potential problems
	SA10	Verifies team readiness to meet operational demands
	SA11	Communicates when situations "feel" wrong

5 Conclusion

For long-duration space flights, numerous critical procedures have to be designed (e.g., docking, maintenance of life support systems, maintenance of power systems, etc.). To help preparing these flights, we propose an information system, based on Skill Agents concepts [2], focusing on dynamic evolution of simulation procedures or scenarios. A detailed assessment of our approach is currently underway.

This work opens some interesting research perspectives. For example, we can cite the optimization of mechanisms dedicated to identification and modelling of environmental contexts that increase the risk of a dangerous event. Another one is the deepening of mechanisms used by ECs to dynamically candidate, and therefore to build an efficient "risk treatment plan".

References

1. Baggerman, S.D., Rando, C.M., Duval, L.E.: Habitability and human factors: lessons learned in long duration space flights. In: Proceedings of the AIAA Space 2004 Conference and Exhibit, San Diego, USA (2004)
2. Chator, O., Salotti, J.M., Favier, P.A.: Human cooperation improvement using autonomous skill agents. Int. J. Adv. Intell. Syst. **7**(1&2), 51–63 (2014)
3. NASA, International Space Station Human Behavior and Performance Competency Model, NASA/TM–2008–214775, vol. 2, USA (2008)
4. O'Keefe, W.: Space flight resource management training for international space station flight controllers. In: AIAA SPACE 2008 Conference & Exposition, USA (2008)
5. Sandor, A., Schuh, S.V., Gore, B.F.: Evidence Report: Risk of Inadequate Critical Task Design, report of the Human Research Program Space Human Factors and Habitability. NASA Lyndon B. Johnson Space Center, USA (2013)
6. Shappell, S.A., Wiegmann, D.A.: The Human Factors Analysis and Classification System–HFACS, report DOT/FAA/AM-00/7. University of Illinois at Urbana-Champaign, Institute of Aviation, USA (2000)
7. Stamatelatos, M., Dezfuli, H.: Probabilistic Risk Assessment Procedures Guide for NASA Managers and Practitioners. NASA, USA (2011)
8. Steinberg, S.: 2014 Space Human Factors Engineering Standing Review Panel. Technical Report, NASA, USA (2014)
9. United Space Alliance, Shuttle Crew Operation Manual, report OI-33, Rev. A. CPN-1, USA (2008)
10. Weiss, G.: Multiagent Systems, a Modern Approach to Distributed Artificial Intelligence. MIT Press (2013)

The Role of Crowdfunding as a Business Model in New Media Industry

Anna Szopa, Tadeusz Marek and Magdalena Fafrowicz

Abstract The business models in new media industry are in transformation. The Internet's impact (both technological impact as well as participatory culture), decreasing readership, and audience fragmentation are among the most influential factors putting into question media management practices. In this changing scenario, the quest for new funding models of media is a priority. One new potential revenue source is crowdfunding—a distributed funding model in which projects funded by small donations or payments from a large crowd of people. In presented article a special attention is given to the case of new media. The focus of inquiry of this paper lies in exploring crowdfunding platforms. Finally, the role of crowdfunding as a funding model for new media is considered.

Keyword Crowdfunding · New media · Business model

1 Introduction

The 21st century has been defined by the rise of digital culture. The Internet has changed how people cooperate and react to almost every aspect of daily life. It has also determined how people express themselves through blogs, websites, videos, pictures, and other user-generated media. Online communications and communities have been at the center of most major events. New media, provide the potential for a public sphere, in which citizens can participate in well informed, non-hierarchical debate pertaining to their social structures. According to Ed Herman and Robert McChesney new media is recognized as powerful transnational telecommunications corporations who achieve a level of global influence.

The new systems allow the Internet to facilitate interactions between users, and activities such as crowdfunding that offers new ways to help individuals and

A. Szopa (✉) · T. Marek · M. Fafrowicz
Department of Neuroergonomics, Jagiellonian University, Gołębia 24, 31-007 Kraków, Poland
e-mail: ania.szopa@uj.edu.pl

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businesses fund projects by small donations or payments from a large crowd of people. Accelerating the process of innovation and market adoption increase the attractiveness of distributed online financing. Crowdfunding is now experiencing rapid growth—resource deficient entrepreneurs utilize crowdfunding as an innovative capital management mechanism [6].

Crowdfunding in new media has become increasingly common in recent years. Crowdfunding platforms such as Kickstarter, Indiegogo, Beacon, or Kiva have enabled crowdfunding for new media, which cover a large array of issues. With respect to the existing literature, this paper will provide theoretical framework on the role of crowdfunding as a business model in new media. This article will be guided by two research questions. Firstly what kind of crowdfunding platforms are used to finance new media and why? And, how does crowdfunding change the relationship between the public, who is helping to fund the work?

2 The Essence of Crowdfunding Business Model

The most current definition says that crowdfunding significates the collective co-operation of online individuals who pool their money for a project or product [2, 7, 8, 11, 12]. The power in crowdfunding business model remains in the quantity of funders, the process aims for large numbers of funders. Through crowdfunding, an individual or an organization can raise funding for their ventures.

Crowdfunding is important for creating interest in new projects in the early stages of development [5]. It takes traditional business processes into an online environment, enabling entrepreneurs to encourage and develop business. Features such as online-based communities and interaction mechanisms generate new settings for capital assembly, suggesting the potential for distinctive or novel entrepreneurial processes and potentially different success drivers [4].

From social and psychological perspective crowdsourcing establish a convincing investment story distinct from the novel product or service attributes. According to researchers Paul Resnick and Robert Kraut contributing to online communities, includes desire for knowledge, social standing, peer companionship, approval, desire to improve society [13]. Although crowdfunding model is financially driven, funders obtain value from the sense of community associated with the process itself [11, 12].

In reference to the service organizations in value networks crowdfunding business model stimulates proactive roles for consumers, such as selecting new initiatives and enables the organization of a large number of customers in specific communities within a relatively short period of time.

Furthermore, at the initial stage crowdfunding potentially facilitates the collective development of a business plan or other knowledge exchange, which judges rather than co-creates the business plan it also facilitates testing, promoting, and marketing processes and may be able to use these ecosystems to increase market

awareness and receive customer feedback. It may be considered as a product pre-ordering model that enables price discrimination among early adopters [2].

3 Crowdfunding Platforms

Crowdfunding platforms provide opportunities to present a project to social network and beyond to gather funds—depend on an online social community. With the development of crowdfunding platforms, there is observed an increase of additional services that have emerged to act as the boundary between the funders and the proposed projects. The main aim of crowdfunding platforms is the facilitation of transactions. In that sense, platforms reduce the transaction costs and law complexity that is characteristic in the market. Therefore these platforms are effectively and successfully disseminating the projects to the audience [14].

The literature characterizes four models of crowdfunding: reward, donation, lending, and equity-based represented by crowdfunding platforms—the diversity between crowdfunding models is presented in the goals of the entrepreneurs and supporters. In the case of reward-based crowdfunding (most popular online model) entrepreneurs are characterized as project creators and project supporters represent early customers or co-makers. Lending-based model link creators and supporters in a borrower and lender relationship In donation-based models, project creators are the entrepreneurs while supporters serve as patrons. Lending and equity based models are based on investment mechanisms, and the equity-based model is forming an entrepreneur-investor relationship [11, 12]. In reward based model projects commonly have mechanisms integrated into the structure. Reward structure is as follow: the more capital the funder provides, the higher the value of the reward receives [10]. The world's largest reward based platform is Kickstarter dedicated for such new media industries as film, music, art, games, comics, design, photography etc. In certain cases rewards called "patronage perks" offer more exclusive access to interactions with the creators [1]. Crowdfunded patronage productions is becoming very common- on Patreon platform supporters contribute to YouTube videos, music, science, webcomics artists, or podcasters. The donation-based crowdfunding model corresponds with models of social entrepreneurship where communities involve no monetary compensation for contribution. Due to the fact the consumption of public goods cannot be withdrawn from non-contributors, "free-riding is a potential issue in which contributions can be crowded-out by the prior funding decisions of others" [16]. JustGiving platform provides safeguards in place to protect all donations made through the site and, uniquely, passing these on to charity of a donation being made. In lending-based crowdfunding, funders expect to receive back the capital they contribute to a project with interest. In this model, founders rather invest in ventures that are already supported to reduce risk [18]. Kiva.org is one of the best known micro-lending platform. They act as neutral facilitators both for the project initiators

and the crowdfunders. Kiva has proven procedures and the software through which the funds are collected and administered in addition organize.

Public relations, and make arrangements with micro-payers. Kiva provides founding for businesses in developing countries, supports such areas as journalism, science, music and science. In equity-based model the contributors receive equity and/or shared revenue in return for their investment. It makes possible for anyone to take the role of an investor and receiving equity or shares Presented model is preferable to small businesses because it would allow creators more control over their businesses [3]. Crowdcube, based in England, which focuses strictly on monetary gains via equity, venture funding, and mini-bonds. Startups are spread throughout a variety of new media industries.

All four models of crowdfunding: reward, donation, lending, and equity-based represented by crowdfunding platforms can be used to support new media industry.

4 The Emergence of Crowdfunding in New Media Industry

Henry Jenkins in Convergence Culture: Where Old and New Media Collide explains that the convergence of old and new media means consumers of media, and describes them as follow: "A teenager doing homework may juggle four or five windows, scan the Web, listen to and download MP3 files, chat with friends, word-process a paper, and respond to e-mail, shifting rapidly among tasks. And fans of a popular television series may sample dialogue, summarize episodes, debate subtests, create original fan fiction, record their own soundtracks, make their own movies—and distribute all of this worldwide via the Internet". In new model of media users actively take part in its production through activities like blogging, uploading photos and videos" [8]. In reference to the process; the new media involves the audience and allows participants to communicate with another and generate their own content, rather than have media organizations simply provide the content for the audience to accept or reject [9]. The importance of new media is seen as part of socio-cultural and technological change. New media are associated with a replacement of an industrial age of manufacturing by intensifying processes of globalization. In this sense new media refer to: new textual experiences including new patterns of media consumption, new ways of representing the reality, new experiences of the relationship between embodiment, identity and community, new relationships between subjects (users and consumers) and media technologies, new patterns of organization and production.

Many of the barriers to entry and existence on new media market are far lower than they would have been for analogue media production. New media representatives (artisans, designers, software engineers) can develop new project as the

intellectual property that underpins a platform or application. However the platform only turns out to be a viable product when it attracts an income stream and in addition it cannot become a significant new media object until it finds an audience [15].

Crowdfunding represents an apparently novel platform for new media funding. Its underlying practices and mechanisms including the resource-based perspective, and micro-economic pricing models. The development of social interactions surrounding the new media industries, and the nature of the development is critical. Crowdfunding business model is intended to leverage the "wisdom of the crowd," [17] and due demonstrated interest and positive conversation about a given project stand a driver of project legitimacy [5]. Crowdfunding platforms provide opportunities to present a project to social network and beyond to gather funds—depend on an online social community. With the development of crowdfunding platforms, there is observed an increase of additional services that have emerged to act as the boundary between the funders and the proposed projects The main aim of crowdfunding platforms is the facilitation of transactions. In that sense, platforms reduce the transaction costs and law complexity that is characteristic in the market. Therefore these platforms are effectively and successfully disseminating the projects to the audience.

5 Summary

New media industry needs include both the market, in the sense of a funding collection and more generalised sense different relationships between producers and users. From the development of Web 2.0 to crowdsourcing and beyond, the platforms allow online communities to conjoin around shared projects—give new control to individuals in a way that disrupts traditional business models. Due to crowdfunding business model the funders are able to direct new media through their financial support. Crowdfunding can create "new social interactions that motivate the crowd to participate in the funding of projects, offering 'feelings of connectedness to a community with similar interests and ideals' for crowdfunders" (Belleflamme, Lambert, and Schwienbacher). Crowdfunding in new media has become increasingly common in recent years. Crowdfunding platforms such as Kickstarter, Patreon, Kiva enabled crowdfunding for new media.

References

1. Beer, S., Badura, K.: The new renaissance: a break-through time for artists. Berkeley J. Entertain. Law. **1**(1), 66–74 (2012)
2. Belleflamme, P., Lambert, T., Schwienbacher, A.: Crowdfunding: an industrial organization perspective. J. Econ. Lit. **48**(3), 833–840 (2010)

3. Belleflamme, P., Lambert, T., Schwienbacher, A.: Crowdfunding: tapping the right crowd. Forthcom. J. Bus. Ventur. **29**(5), 585–609 (2013)
4. Bock, A., Frydrych, D., Kinder, T., Koeck, B.: Exploring Entrepreneurial Legitimacy in Reward-Based Crowdfunding. Working Paper: http://www.research.ed.ac.uk/portal/files/14896499/BOCK_Exploring_Entrepreneurial_Legitimacy.pdf (2014)
5. Burtch, G., Ghose, A., Wattal, S.: An Empirical Examination of the Antecedents and Consequences of Investment Patterns in Crowdfunded Markets, pp. 4–7. ICIS Press, Shanghai (2011)
6. Harrison, R.: Crowdfunding and the revitalisation of the early stage risk capital market: catalyst or chimera. Ventur. Cap. Int. J. Entrep. Finance **15**(4), 283–287 (2013)
7. Howe, J.: The rise of crowdsourcing. Wired Mag. **14**(6), 1–4 (2006)
8. Kleemann, F.G., Voss, G., Rieder, K.: Un(der)paid innovators: The commercial utilization of consumer work through crowdsourcing. Sci. Technol. Innov. Stud. **4**(1), 5–26 (2008)
9. Lister, M., Dovey, J., Giddings, S., Grant, I., Kelly, K.: New Media: A Critical Introduction. Milton Park, Abingdon (2008)
10. McKelvie, A., Wiklund, J.: Advancing firm growth research: a focus on growth mode instead of growth rate. Entrep. Theory Pract. **34**(2), 261–288 (2010)
11. Mollick, E.: The dynamics of crowdfunding: an explorative study. J. Bus. Ventur. **29**(1), 1–16 (2014)
12. Mollick, E.: The dynamics of crowdfunding: an exploratory study. J. Bus. Ventur. **29**(1), 1–16 (2014)
13. Resnick, P., Kraut, R.: Evidence-Based Social Design: Introduction in Evidence-Based Social Design: Mining Social Sciences to Build Online Communities. MIT Press, Cambridge (2014)
14. Schwienbacher, A., Larralde, B.: Crowdfunding of small entrepreneurial ventures. In: Cumming, D. (ed.) The Oxford Handbook of Entrepreneurial Finance, pp. 369–391. Oxford University Press (2010)
15. Smith, A.: Goodbye Gutenberg: The Newspaper Revolution of the 1980s. Oxford University Press, Oxford (1981)
16. Smith, S., Windmeijer, F., Wright E.: The Effect of Social Information on Charitable Donations: Evidence from the (Running) Field, University of Bristol Working Paper (2012)
17. Surowiecki, J.: The Wisdom of Crowds: Why the Many are Smarter than the Few and How Collective Wisdom Shapes Business, Economies, Societies, and Nations. Doubleday, New York (2004)
18. Zhang, J.J., Liu, P.: Rational herding in microloan markets. Manage. Sci. **58**(5), 892–912 (2012)

Leader Integrity and Employee Outcomes: Where Do They Collide?

Kwasi Dartey-Baah and Reginald Arthur

Abstract This study samples 270 employees from Ghana's Civil Service to examine their perception of their leaders and the relative influence this leadership attribute has on their citizenship and unproductive behaviours at the workplace. The study finds that leader integrity is strongly related to the OCB of followers but has no significant relationship with their deviant behaviours. The study thus recommends that managers be mindful to demonstrate integrity in the search for positive employee outcomes. This study is the first to examine the relationship between these variables in an African context.

Keywords Leader · Integrity · Civil service · Counterproductive behaviour · Citizenship behaviour · Employee outcome

1 Introduction

The focus on examining leadership from the perspective of the various styles and models of leadership behaviour [2] is shifting in recent times to an assessment of positive leadership behaviours that culminates in positive employee outcomes [15, 31]. This is because leadership which unarguably has been attributed as the prime determinant of organizational success has been cited amongst various incidents of corporate and government scandals [12, 30]. The growing trend of organizational failures as a result of leadership character flaws has led to increasing calls for more positive leadership behaviours in both management literature and practice such as leader integrity.

Complimentarily, the past few years has witnessed leadership studies linking character strengths of leaders, specifically leader integrity, with positive organizational outcomes [15, 24, 31, 33]. Nonetheless, as much as the search for more

K. Dartey-Baah (✉) · R. Arthur
Department of Organisation and Human Resource Management,
University of Ghana Business School, P.O. Box LG 78, Legon, Accra, Ghana
e-mail: kdartey-baah@ug.edu.gh

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positive leadership characters abound and studies that seek to link leader integrity and organizational outcomes continue to dominate recent leadership studies, there appears to be lack of empirical studies that establish the relationship between leader integrity and voluntary employee behaviours, particularly, organizational citizenship behaviour (OCB) and counterproductive work behaviours (CWB) (for an exception, see Zhang et al. [33]. The study of Zhang and his friends [33] investigated how leader integrity influences the citizenship behaviour of subordinates mediating the relationship with leader effectiveness. Though their study provided some profound findings about the relationship between the two concepts (leader integrity and OCB), the study only focused on an aspect of voluntary behaviour, that is OCB, neglecting how leader integrity could also influence CWB, which extant literature has shown is not necessarily a negative concept to OCB and thus may not always have an opposite outcome to OCB [4, 14]. Furthermore, the study of Zhang et al. [33] was conducted in the Chinese setting and thus though could be generalized to reflect the leader integrity—OCB relationship in similar jurisdictions, may suffer being generalized beyond the Chinese context. This is because a comprehensive study across six different cultures (Ireland, the U.S.A, Germany, Austria, China and Hong Kong) by Martin et al. [20] found that there were differences in the meaning and emphasis various cultures placed on the concept of leader integrity. This means that studies on leader integrity have to consider the cultural cluster of the context within which the study is being conducted, therefore limiting the scope of the study by Zhang et al. [33].

The primary research question of this study therefore purports to addresses the relationship that exists between leader integrity and two distinct forms of employee behaviours that have positive and harmful impacts on organizational performance, that is, OCB and CWB respectively.

2 Theoretical Grounding and Hypotheses Development

2.1 Leader-Member Exchange Theory

This study is predicated on the leader-member exchange (LMX) theory to explain the relationship that exists between the integrity of a leader and how such leadership attribute influences employee outcomes including OCB and CWB. LMX focuses on the dyadic relationship between a leader and the follower [6, 16]. This relationship is usually based on mutual trust and respect [9]. The dyadic relationship in the LMX theory is as a result of a sequence of exchanges that occurs between the leader and follower. That is, the exchange is mutual and may be in the form of the leader being honest and fair with followers who in return provide more positive outcomes as a result. Each party in the relationship show individual commitment to the relationship through the expectations and demands of the relationship.

Drawing from the social exchange theory and concept of reciprocity, the LMX theory could be understood in the sense that the retention of the relationship between the leader and follower is contingent on the perception of each other that their output from the relationship is proportionate to their input [3]. In other words, it can be deduced from the LMX theory that the outcome of followers in the leader-member exchange relationship will be dependent on their perceptions of the leader treating them with honesty, fairness, transparency and also the followers having the ability to trust in the leader. Greenberg [17] explains that the absence of quality relationships such as fair treatments, abuse and lack of trust will result in employee withdrawal behaviours such as theft, passive commitment to the organization or even high turnovers.

The integrity of a leader thus constitutes a prerequisite for high-quality leader-follower relationships. In other words, the integrity of a leader would determine employee outcomes such as OCB and CWB because it involves a demonstration of attributes that influences the quality of relationship between the leader and follower. This means that a leader demonstrating high levels of integrity is more likely to elicit positive outcomes such as OCB under the LMX theory and a leader with low levels of integrity is more likely to elicit destructive employee behaviours such as CWB. Although there appears to be a paucity of evidence that supports the direct relationship between leader integrity, OCB and CWB, the study of Zhang et al. [33] and Dineen et al. [11] who found in their study that high behavioural integrity of managers was positively related to employee organizational citizenship behaviours while low behavioural integrity of managers was positively related to unproductive employee behaviours. Based on the theoretical evidence provided by the LMX theory and the empirical studies above, it is hypothesized that:

HI: Leader integrity will be positively related to follower OCB

H2: Leader integrity will be negatively related to follower CWB

2.2 Organizational Citizenship Behaviour

The commonest definition of organizational citizenship behaviour (OCB) is that propounded by Organ [21]. According to Organ [21], OCB is an "individual behaviour that is discretionary, not directly or explicitly recognized by the formal reward system, and that in the aggregate promotes the effective functioning of the organization. By discretionary, we mean that the behaviour is not an enforceable requirement of the role or the job description, that is, the clearly specifiable terms of the person's employment contract with the organization; the behaviour is rather a matter of personal choice, such that its omission is not generally understood as punishable" (p. 4). This traditional definition of OCB has suffered criticisms because it places the concept in the category of extra-role behaviours, that is, behaviours that are beyond the job requirements of an individual [7].

Though the original work of Organ [21] has led to the development of several dimensions of OCB (for instance, [26, 32]), this study will focus on the original five dimensions (altruism, conscientiousness, sportsmanship, courtesy, civic virtue) of OCB proposed by Organ [21]. The use of these dimensions is premised against the background that there appears to be no study conducted in Ghana aimed at examining OCB in the civil service in particular. Authors such as Paine and Organ (2000) have indicated that the cultural context of a particular country is likely to influence the citizenship behaviours of employees in that country. In the same vein, there is enough evidence that supports the fact that national cultures usually have an influence on organizational culture as extensively explained by Dartey-Baah [10] and Hofstede [18]. As such there appears to be a unique opportunity for this study to contribute empirically to the limited literature on the study of OCB in the Ghanaian culture should the original dimensions of OCB be employed in this study. Again, the civil service is a unique sector where the behaviours and attitudes of workers are quite distinct from the private sector especially in developing countries such as Ghana. Somech and Drach-Zahavy [29] makes strong arguments for sector specific categorizations of OCBs and thus proposes three forms of OCB for educational settings. The civil service constitutes a very identifiable category of typical public servants where there is overcrowding and the demand of work appears less than the number of workers performing the job. It is therefore anticipated that the job characteristics of the civil service will provide nascent findings of OCB in the public sector.

Dimensions of OCB. *Altruism.* Organ [21] uses the dimension of altruism to a show of selfless concern for the welfare of other people in the organization. The Ghanaian culture is highly collectivist and a demonstration of helping behaviours is highly considered as a norm and demonstration of communal spirit. It is therefore expected that when leaders are presumed to have high levels of integrity, followers would demonstrate high levels of altruistic behaviours. It is therefore hypothesized that:

H1a: Leader integrity will relate positively to follower altruism

Conscientiousness. Also referred to as generalized compliance, (Connell [7] conscientiousness refers to more "impersonal contributions to the organization such as excellent attendance, and adherence to organizational rules and policies". A leader that demonstrates integrity is highly likely to build trust and elicit unequivocal adherence from employees because leader integrity is a desirable attribute. It is therefore hypothesized that

H1b: Leader integrity will relate positively to follower conscientiousness

Courtesy. Courtesy as a dimension of OCB refers to those behaviours that are aimed at preventing other workers from falling into problems [21]. The relevance of this dimension is in the fact that it describes behaviours that aid in promoting effectiveness at work and help foster bonds of cooperation among workers [22]. Again, the collectivist culture of Ghanaians is expected to play a dominant role in encouraging courteous behaviours from employees. It is therefore hypothesized that:

H1c: Leader integrity will relate positively to courtesy behaviours of followers

Sportsmanship. Sportsmanship is among the commonest dimensions of OCB [21, 22]. It refers to "the inclination to absorb minor inconveniences and impositions accruing from the job without complaints or excessive demands for relief or redress [19, p. 255]. It refers to an attitude of tolerance at the workplace. The high levels of communal spirit that exists in the Ghanaian context leads to the expectation that:

H1d: Leader integrity will relate positively to follower sportsmanship

Civic Virtue. Civic virtue, refers to total commitment and involvement in the issues of the organization as well as the political process and governance of the organization [21]. Just as in the show of national civic responsibility, this dimension involves keeping abreast with organizational issues through the reading of company mails, stating your opinions on organizational issues through appropriate channels as and when it is appropriate and making oneself relevant in the overall governance of the organization [19]. It thus hypothesized that:

H1e: Leader integrity will relate positively to the civic virtue of followers

2.3 Counterproductive Work Behaviour

Counterproductive Work Behaviour (CWB) is generally defined as behaviours that are harmful to the legitimate interests of an organization [5]. According Fox et al. [13], these behaviours are "harmful to the organization by directly affecting its functioning or property, or by hurting employees in a way that will reduce their effectiveness" (p. 292). They include behaviours such as theft, taking long breaks during working hours, absenteeism, overbilling an organization through presenteeism, showing aggressive behaviours towards employees and destruction of company property (behaving aggressively toward other employees [5, 25].

Rahim et al. further describe CWB with respect to the direction of such behaviours. They therefore categorize CWB as organizational CWB (CWBO) and individual CWB (CWBI). These categorizations of CWB so far remains the most popular dimensions of the concept. Organizational CWB is described as comprising property CWB and production CWB, referring to unproductive behaviours directed at the organization through the destruction of organizational assets and deviant behaviours that have detrimental effects on the organization by way of compromising the quantity and quality of work that the organization could produce respectively. When a leader demonstrates integrity, it is expected that the followers would trust in the leader and thus engage more in desirable behaviours. Followers are therefore less likely to engage in behaviours that are harmful to the organization because they would perceive the leaders attitude as caring and one that considers his welfare. Drawing from the LMX theory, it is expected that there would be an

inverse relationship between the integrity of a leader and unproductive behaviours of employees towards the organization. It is therefore hypothesized that:

H2a: Leader integrity will be negatively related to unproductive follower behaviours towards the organization.

Individual CWBs are also categorized into political CWB and personal aggression by Rahim and his friends. They define political CWB as those behaviours that politically disadvantages another person in the organization. Personal aggression is also used to describe hostile behaviours that are shown towards other individuals at the workplace. A leader that has integrity is likely to build a quality relationship with his or her followers. Evidence from the leader-member exchange shows that followers who find themselves subordinated to leaders who demonstrate preferred attributes like integrity would also reciprocate it with positive outcomes. Further to this, followers considering the latitude of the relationship would not want to break a high quality relationship and therefore would engage more in positive rather than harmful behaviours in order to keep the trust that exist between them and their leader. It is there expected that leaders who demonstrate high levels of integrity would discourage deviant behaviours of employees towards other individuals in the organization. It is thus hypothesized that:

H2b: Leader integrity will relate negatively to harmful behaviours from followers towards their colleagues.

3 Method

3.1 Participants and Procedures

The study was a conducted as a cross-sectional survey where data was collected from 270 Ghanaian Civil Servants at only one point in time. The Ghanaian Civil Service was considered an appropriate context for this study because in recent times, there have been several calls for high levels of integrity and productive service from the Ghanaian Civil Service due to the continuous decline in integrity and performance of the service.

The respondents were sampled from 12 out of the 22 central government ministries in Ghana. The inability to sample respondents from all the ministries were largely due to the lack of approvals given for the research to be carried out in those ministries that were left out.

The questionnaires were self-administered to the respondents who were asked to complete them immediately or at a later time because of their work schedules. The sample used was representative of Civil Servants in the various central government ministries in Ghana. The demographics of the respondents show that 68 % were males and 32 % were females. The respondents were spread across departments

including research, audit, finance, human resource management, public relations and information technology among others. 92 % of the respondents had at least a bachelors degree while 96 % of the respondents have had at least more than 4 years of work experience in the service. Also, more than 82 % of the respondents were 41 years of age or older. This provided evidence to the fact that there still a considerable level of imbalance between male and female workers in the Ghanaian civil service and the high rate of superannuation that exists in the Ghanaian Civil Service [27].

3.2 Measures

Leader Integrity. To measure leader integrity, a revised Perceived Leader Integrity Scale by Craig and Gustafson [8] was used to measure the perceived integrity of the immediate supervisors of the respondents. The revised PLI scale is a 4-Point Likert Scale with responses ranging from "not at all" to "well" (1 = Not at all, 2 = Barely, 3 = Somewhat, 4 = Well). It has items which refer to the immediate supervisor of a respondent and includes items such as; "Would lie to me, would risk other people to protect himself/herself in work matters". The reliability of the scale was 0.75.

Organizational Citizenship Behaviour. To measure the organizational citizenship behaviour of the respondents, an OCB measure developed by Podsakoff et al. (1990) was adopted for this study. The scale describes five dimensions including altruism, conscientiousness, sportsmanship, courtesy and civic virtue using 24 items on a 5-point Likert-type scale (1 = never….5 = Always). Sample items included: "I help other who have been absent, I willingly help others who have work-related problems." The reliability of the scale was 0.83.

Counterproductive Work Behaviour. Aquino et al. [1] Deviant Behaviour scale which uses 14 items to describes two dimensions (interpersonal deviance and organizational deviance) of deviant employee behaviours was used to measure CWB. The scale also uses a 5-point Likert-type scale (1 = never….5 = Always) to obtain responses. Among the items on the scale were: "Publicly embarrassed someone at work, Taken property from work without permission,". The reliability for this scale was 0.81.

4 Results

The hypothesis for this study was tested using Pearson's product moment correlation coefficient (Pearson r). The results of the analyses are presented in Table 1. The means, standard deviations and correlations among the study variables are therefore provided in Table 1.

Table 1 Pearson product moment correlation among variables

	Variables	Mean	SD	1	2	3	4	5	6	7	8	9	10
1	Leader integrity	42.50	5.9	1.00									
2	OCB	96.67	11.4	0.71*	1.00								
3	Altruism	20.17	1.6	0.41*	0.51	1.00							
4	Conscientiousness	21.05	8.7	0.04*	0.78	0.10	1.00						
5	Sportsmanship	16.76	4.6	0.08	0.61	0.55	0.18	1.00					
6	Courtesy	21.61	3.7	0.17	0.39*	0.15	−0.02	0.07	1.00				
7	Civic virtue	17.09	1.6	0.32*	−0.20*	0.17*	−0.38*	−0.19*	−0.02	1.00			
8	CWB	34.27	4.7	−0.59	−0.40*	−0.67*	−0.01	−0.52*	−0.22*	−0.23*	1.00		
9	CWB-individual	13.34	2.2	−0.38*	−0.37*	−0.62*	0.00	−0.51*	−0.15*	−0.15*	0.90*	1.00	
10	CWB-organization	20.94	2.9	−0.66	−0.38*	−0.62*	0.02	−0.46*	−0.24*	−0.25*	0.94	0.70*	1.00

Note N = 270; *p < 0.05

The correlation matrix in Table 1 showed a significant positive relationship between leader integrity and OCB ($r = 0.71$, $p < 0.05$). This supported Hypothesis 1 which suggested that leader integrity will be positively related with follower OCB. The study also sought to investigate the relationship between the various dimensions of OCB and leader integrity. From the correlation matrix, it was shown that there was a significant positive relationship between leader integrity and follower altruism ($r = 0.41$, $p < 0.05$). This finding was in support of Hypothesis 1a which suggested a positive relationship between leader integrity and follower altruism. Again, the matrix showed a significant positive relationship between leader integrity and follower conscientiousness ($r = 0.04$, $p < 0.05$). This means that the Hypothesis 1b which suggested that leader integrity will relate positively to follower conscientiousness was supported. Also, the correlation matrix above showed no significant relationship between leader integrity and follower sportsmanship as well as courtesy behaviours respectively ($r = 0.08$, $p > 0.05$; $r = 0.17$, $p > 0.05$). These findings therefore provided no support for Hypothesis 1c and 1d respectively. The correlation matrix also showed a significant positive relationship between leader integrity and the civic virtue of followers ($r = 0.32$, $p < 0.05$). This means that Hypothesis 1e which suggested a positive relationship between leader integrity and follower civic virtue was supported. Furthermore, the correlation matrix showed no significant relationship between leader integrity and follower CWB ($r = -0.59$, $p > 0.05$). This finding therefore provided no supported Hypothesis 2 that predicted that leader integrity will be negatively related to follower CWB. Examining the CWB—leader integrity nexus from a dimensional perspective, the matrix showed that there was no significant relationship between leader integrity and CWB towards the organization ($r = -0.66$, $p > 0.05$). This finding therefore did not support Hypothesis 2a that predicted that leader integrity will relate negatively to harmful behaviours from followers towards their colleagues. Finally, the correlation matrix revealed a significant and negative relationship between leader integrity and CWB towards individuals in the organization ($r = -0.38$, $p < 0.05$). This provided confirmatory evidence to Hypothesis 2b which suggested that leader integrity will be negatively related to unproductive follower behaviours towards the organization.

5 Discussion

The study aimed to provide empirical evidence to the direct relationship between leader integrity, OCB and CWB. From the findings of the study, it was revealed that leaders that demonstrate high levels of integrity influence positively the OCB of their followers. This is in confirmation of previous studies done by Zhang et al. [33] and Dineen et al. [11]. This study further extends the findings of previous research on the relationship between the two concepts to examine how leader integrity relates with the dimensions of OCB. The study shows that leaders that demonstrate high levels of integrity are able to influence followers to engage more in

praiseworthy behaviours such as helping their colleagues at work, working to create a healthy organizational climate that promotes peace and enhance coordination of activities and increased commitment to non-core organizational activities as well as governance processes.

The study however found no significant relationship between leader integrity and follower sportsmanship and courtesy. The closeness of the public sector, particularly the Civil Service as in the case of Ghana, to the political overseers of a country means that there is likely to be several political interference and overlapping of political decisions which in the work of the Civil Servants. These interferences may require some level of dissent based on an individual's values and moral beliefs. As such, it may be understandable that as much as leader integrity may influence the overall citizenship behaviour of employees, he or she may have less influence on the courtesy behaviour of such employees.

Furthermore, the lack of significant relationship between leader integrity and followers sportsmanship may be attributed to Ghanaian culture that is collectivist but at the same time high in power distance. According to Hofstede [18], power distance cultures are those in which there is high tolerance for inequality based on power, status and wealth. In power distance cultures like Ghana, employees are found to be more united among themselves than they probably would be with their superiors due to the inequality in status. Hence, employees may be more likely to reward cooperation amongst themselves than reward bond of trust they may find in an individual with a higher status, that is, their superior. This cultural underpinning could therefore explain the fact that the demonstration of sportsmanship may be less influenced by leader attributes such as the demonstration of integrity. Rather, cooperation amongst employees may define the demonstration of positive behaviours such as sportsmanship.

Again, the study found no significant relationship with CWB. This means that presence or lack of demonstration of integrity by a leader has no influence on the desire of employees to engage in unproductive and deviant behaviours at the workplace. This finding contrast the study of Dineen et al. [11]. There are not much studies that seek to support this finding or contest it but inferences could be drawn from the antecedents of counterproductive work behaviour. Among the antecedents of CWB are personality traits of individuals, demands of job and job insecurity, organizational justice, work-life balance and behaviour of customers among others [28]. Leadership behaviours appear not be considered as among the antecedents as shown by past researchers. Furthermore, Rahim et al. conclude that job related factors such as job demands are the most pertinent factors that influence CWB at the workplace. This is because employees are considered to spend more time on the job and thus will be much affected by factors emanating from the job. It can therefore be speculated that other factors such as pay, work conditions and job roles are among those that will influence most the behaviour of civil servants in Ghana.

5.1 Limitations and Future Research

This study focused on Civil Servants from only the central government ministries. The exclusion of the civil servants at the local government level from the sample used for this study might make the external validity of the findings of this study quite problematic.

Nonetheless, the researchers were not interested in assessing Civil Servants decentralized in the other regions of the country since their functions were only duplicated the activities of the various ministries at the local level.

Another limitation that this study may suffer from is the explanation of causality among the variables. This study recognizes that the determination of causality in such a study would require some rigorous test and methods which have not been adopted in this study. The study however sought to provide a description of the relationship between the variables used and thus the adoption of the correlation matrix was considered sufficient.

It is nonetheless recommended for future research to adopt more rigorous analytical methods to examine the causality between the variables. This would further enhance knowledge about the relationship between leader integrity and employee outcomes. Also, an examination of the causality between OCB and CWB would also be highly relevant for future studies.

5.2 Practical Implications of Study

This study brings the concept of integrity to the doorstep of leaders. Leaders in organizations must not only concern themselves with using working conditions to motivate employees for high performance. Managers should equally pay attention to building their personal integrity as it has been discovered that this encourages employees to engage more in citizenship behaviours.

Besides, it is recommended that other factors such as organizational justice and work life balance must be upheld in organizations in order not to create an unhealthy climate where employees tend to be more destructive than constructive in the organization. This is because as much as the behaviour of leaders may not directly influence deviant behaviours from employees, managers have a lot of influence on job factors which this study has emphasized has direct influence on counterproductive work behaviour. Managers who seek to reduce unproductive behaviours among employees should thus focus on improving job factors such as workloads, pay and conditions of service together with improving their moral attitude and consistency in the organization.

6 Conclusion

There have been several studies that have sought to establish a relationship between various forms of leadership and employee outcomes. But as Palanski and Yammarino [23] described, integrity is an axiom in leadership and a normative ideal, hence, discussions about positive leadership characteristics that elicit desirable organizational success cannot be concluded without a strong indication of the place integrity has in this relationship. The findings of this study shows that integrity influences followers to demonstrate citizenship behaviours which invariably leads to organizational success. Though it has not been shown that the absence of integrity may necessarily lead to employees engaging in unproductive and harmful behaviours in the organization, there exist some indirect relationship between the integrity of a leader, how such integrity influences organizational climate and other factors within the organization and consequentially, its impact on employee deviant behaviours. To conclude, it is highly relevant from the findings of this study that the search organizational success must consciously involve an investigation into the integrity of leadership in the organization.

References

1. Aquino, K., Lewis, M.U., Bradfield, M.: Justice constructs, negative affectivity and employee deviance: a proposed model and empirical test. J. Organ. Behav. **20**, 1073–1091 (1999)
2. Avolio, J.B., Walumbwa, F.O., Weber, T.J.: Leadership: current theories, research, and future directions. Annu. Rev. Psychol. **60**, 421–449 (2009)
3. Blau, P.: Exchange and Power in Social Life. Wiley, New York (1964)
4. Bolino, M.C., Turnley, W.H., Niehoff, B.P.: The other side of the story: reexamining prevailing assumptions about organizational citizenship behavior. H. Res. Manage. Rev. **14**, 229–246 (2004)
5. Campbell, W.K., Hoffman, B.J., Campbell, M.S., Marchisio, G.: Narcissism in organizational contexts. Hum. Res. Manage. Rev. **21**, 268–284 (2011)
6. Cogliser, C.C., Schriesheim, C.A.: Exploring work unit context and leader-member exchange: a multi-level perspective. J. Organ. Behav. **21**, 487–511 (2000)
7. Connell, P.: Transformational Leadership, Leader-Member Exchange (LMX), and OCB: The Role of Motives. A Dissertation Submitted in Partial Fulfilment of the Requirements for the Degree of Doctor of Philosophy. Department of Psychology, College of Arts and Sciences, University of South Florida (2005)
8. Craig, S.B., Gustafson, S.B.: Perceived leader integrity scale: an instrument for assessing employee perceptions of leader integrity. L. Quart. **9**(2), 143–144 (1998)
9. Dansereau, F., Graen, G., Hagan, W.: A vertical dyadic linkage approach to leadership within formal organizations. Organ. Behav. Hum. Perform. **13**, 46–70 (1975)
10. Dartey-Baah, K.: The impact of national cultures on corporate cultures in organisations. Acad. Lead. **9**(1) (2011)
11. Dineen, B.R., Lewicki, R.J., Tomlinson, E.C.: Supervisory guidance and behavioural integrity: relationships with employee citizenship and deviant behaviour. J. Appl. Psychol. **91**, 622–635 (2006)
12. Edelman: Edelman trust barometer. www.edelman.com/insights/intellectual-property/2012-edelman-trust-barometer/about-trust/executive-summary/ (2012). Accessed 8 Feb 2015

13. Fox, S., Spector, P.E., Miles, D.: Counterproductive Work Behavior (CWB) in response to job stressors and organizational justice: some mediator and moderator tests for autonomy and emotions. J. Vocat. Behav. **59**, 291–309 (2001)
14. Galperin, B.L., Burke, R.J.: Uncovering the relationship between workaholism and workplace destructive and constructive deviance: an exploratory study. Int. J. HRM. **17**, 331–347 (2006)
15. Gentry, W.A., Cullen, K.L., Sosik, J.J., Chun, J.U., Leupoid, R.C., Tonidandel, S.: Integrity's place among the character strengths of middle-level managers and top-level executives. L. Quart. **24**(3), 395–404 (2013)
16. Gernster, C.R., Day, D.V.: Meta-analytic review of leader-member exchange theory: correlates and construct issues. J. Appl. Psych. **6**, 827–844 (1997)
17. Greenberg, J.: Employee theft as a response to underemployment inequity: the hidden costs of pay cuts. J. Appl. Psychol. **75**, 561–568 (1990)
18. Hofstede, G.: Culture's consequences, international differences in work-related values (cross cultural research and methodology). Sage, Newbury Park (1980)
19. Konovsky, M.A., Organ, D.W.: Dispositional and contextual determinants of organizational citizenship behaviour. J. Organ. Behav. **17**(3), 253–266 (1996)
20. Martin, G.S., Keating, M.A., Resick, C.J., Szabo, E., Kwan, H.K., Peng, C.: The meaning of leader integrity: a comparative study across Anglo, Asian, and Germanic cultures. L. Quart. **24**, 445–461 (2013)
21. Organ, D.W.: Organizational Citizenship Behavior: The Good Soldier Syndrome. Lexington Books, Lexington (1988)
22. Organ, D.W.: Organizational citizenship behaviour: It's construct clean-up time. Hum. Perform. **10**, 85–97 (1997)
23. Palanski, M.E., Yammarino, F.J.: Integrity and leadership: a multi-level conceptual framework. L. Quart. **20**, 405–420 (2009)
24. Palanski, M.E., Yammarino, F.Y.: Impact of behavioural integrity on follower job performance: a three-study examination. L. Quart. **22**, 765–786 (2011)
25. Penney, L.M., Spector, P.E.: Narcissism and counterproductive work behaviour: do bigger egos mean bigger problems? Int. J. Sel. Assess. **10**, 126–134 (2002)
26. Rioux, S.M., Penner, L.A.: The causes of organizational citizenship behaviour: a motivational analysis. J. Appl. Psychol. **86**(6), 1306–1314 (2001)
27. Sakyi, E.K., Bawole, J.N.: Challenges in implementing code of conduct within the public sector in anglophone West African Countries: perspectives from public managers. J. Public Adm. **1**(4), 068–078 (2009)
28. Salgado, J.F.: The big five personality dimensions and counterproductive behaviours. Int. J. Sel. Assess. **10**, 117–125 (2002)
29. Somech, A., Drach-Zahavy, A.: Understanding extra-role behaviour in school: The relationships between job satisfaction, sense of efficacy, and teachers' extra-role behaviour. Teach. Teach. Educ. **1**(6), 649–659 (2000)
30. Sosik, J.J., Juzbasich, J., Chun, U.J.: Effects of moral reasoning and management level on ratings of charismatic leadership, in-role and extra-role performance of managers: a multi-source examination. L. Quart. **22**, 434–450 (2011)
31. Vogelgesang, G.R., Leroy, H., Avolio, B.J.: The mediating effects of leader integrity with transparency in communication and work engagement/performance. L. Quart. **24**(3), 405–413 (2013)
32. Williams, L.J., Anderson, S.E.: Job satisfaction and organizational commitment as predictors of organizational citizenship and in-role behaviour. J. Manage. **17**(3), 601–617 (1991)
33. Zhang, G., Bai, Y., Gaza, A., Wang, L.: Leader integrity and organizational citizenship behaviour in China. Manage. Organ. Rev. **10**(2), 299–319 (2014)

Heterogeneity of Leadership Styles as Behavioral Units: The Role of Personality in Searching for Leadership Profiles

Jolanta Babiak, Beata Bajcar and Czesław S. Nosal

Abstract The main aim of the presented empirical study is verification that leadership styles are not homogenous. Using hierarchical cluster analysis (n = 477), we demonstrated heterogeneity of leadership styles expressed in behavioral configuration of leadership profiles. Individual differences in leadership profiles reflect authentic managerial leading styles, which managers deploy in real organizational circumstances. Presented findings yielded that configurations of leadership styles, i.e. leadership profiles, go beyond a two-dimensional pattern of task- and follower-orientation. This study also determined that there are differences in the personality configuration between leadership profiles (n = 333). By verifying differences in personality traits in each of the leadership profiles, we have also proven that they are psychologically consistent. Results deliver a distinction among leaders who are active, task-oriented, sociable and conscientious labeled Natural leaders; inactive but open to experience, agreeable and rewarding named Pseudo-democrats; active, oriented towards personal achievement, risk oriented and high on neuroticism labeled Machiavellians; and inactive, dysfunctional, absent, low on extraversion and conscientiousness named Pseudo-supervisors. This study shows that authentic managerial leading styles extend beyond "pure" task- or follower-orientation; rather they require abilities to utilize various kinds of behavioral styles in a given situation.

Keywords Leadership styles · Leadership profiles · Authentic behaviors · Personality · Cluster analysis

J. Babiak (✉) · B. Bajcar
Wroclaw University of Technology, Wroclaw, Poland
e-mail: jolantababiak@yahoo.com

C.S. Nosal
University of Social Sciences and Humanities, Wroclaw, Poland

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1 Introduction

The main aim of this chapter is to empirically demonstrate that leadership styles emerging from authentic managerial behaviors are not homogenous entities. Leadership styles are by nature heterogeneous. To answer this question we take into account the interaction between personality traits and variability of situational contingencies as a basis for interpretation of differences among patterns of leadership behavior [1]. Accordingly, heterogeneity of leadership styles manifested in leaders' behavior and represented by varying leadership behavioral profiles is a function of a specific combination of personality traits and situational attributes. It does not exclude however an extreme alternative, among all possible combinations, that leadership styles are solely regulated by situational characteristics or personality traits. Nonetheless, patterns of interactions are the main principle of our interpretation. We believe that this key theoretical tenet, highlighted in social psychology [2], is also applicable to the very nature of differences in leadership styles, emerging as natural behavioral units in the leadership process.

Therefore, in this chapter we made a preliminary attempt to analyze and empirically verify correlates of leadership styles as heterogeneous behavioral units and their links to personality. We are not limiting our search for leadership styles and their trait determinants by focusing on duality e.g. task-people orientation [1], destructive–constructive behavior [3, 4]. We thus propose to revise an assumption of homogeneity of leadership styles. In our study, we attempt to prove that leadership styles produce configurations of different behaviors, which frequency defines characteristic leadership profile. In the current study, we also verify to what extent the emergent and specific leadership profiles are related to personality traits, considered as a general tendency to particular but consistent behaviors manifested in various situations [5].

2 Theory and Hypotheses

Our first goal in this study is to determine the differences in leadership profiles constructed on the basis of various leadership styles. We take into account the following leadership styles: structuring, autocratic, participative, rewarding, Machiavellian, and distant, measured with the Managerial Styles of Leading questionnaire (MSL) [6]. In our analysis, we will first attempt to extract particular leadership profiles and then define their specific dominant behavioral patterns. We thus expect that:

Hypothesis 1 (*H1*) Different leadership styles will dominate within the specific leadership profile.

At the same time, we foresee that:

Hypothesis 2 (*H2*) Extracted profiles will embrace diverse leadership styles extending beyond the dualistic pattern of task- and people-orientation.

Throughout the history of the empirical research on leadership, many reviews have been conducted pertaining to relationships between leadership styles and criteria such as organizational situations' attributes, cognitive abilities, leaders' personality traits and many others [1, 7–12]. However, there are still many scholarly attempts in explaining leadership styles' determinants and generating models of their structure. It seems that more effort is needed to consider the fact that leadership styles are manifested through various dominant behaviors, which produce specific patterns, i.e. leadership profiles. The once dominant two-tier approach explained leadership styles as opposing behaviors within different dimensions, e.g. autocratic—democratic leadership [13], initiating structure—consideration [14], task-oriented—relations-oriented [1], performance-oriented—maintenance-oriented [15], transformational-transactional leadership [7]. The later attempts to analyzing leadership behaviors, like the path-goal literature [16], have taken into account varying leadership behaviors, and went beyond the dominating dualistic approach. In the most current rationale, leadership also embraces destructive forms of behavior, and the search for traits that predict such behavior is a valid topic of research [3, 4, 17]. Our approach does not neglect the value of previous research findings, but it is directed towards searching for psychological accuracy of leadership styles as behavioral units. We think that the term "profile" is more descriptive and explanatory when defining leadership styles as behavioral units. We also believe that managers do not employ precisely "pure" styles of leading, rather they react in a specific way, naturally emerging in the course of gathering experiences, represented by leadership profiles. Fiedler's theory clarifies all conditions, which facilitate the effectiveness of a democratic leadership style [1]. We believe that Fiedler's model, which explains implications of the potential repertoire of leadership styles, is most analogous to the idea of differences in leadership profiles.

Our second goal is to verify to what extent leadership profiles are related to personality defined by a five-factor personality model [18]. We therefore assume that:

Hypothesis 3 (*H3*) Personality traits will relate to leadership profiles such that each leadership profile will be defined by a unique configuration of personality traits.

Among various personality inventories used in leadership studies, NEO-FFI measure [18] of the five-factor model of personality has provided considerable amount of evidence of explanatory and predictive power of the five personality domains for different leadership styles. Various studies have demonstrated [19–21] that extraversion is positively associated with transformational leadership or its components as measured by Multifactor Leadership Questionnaire [7], which encompasses such behaviors as serving as role models, motivating and inspiring followers, encouraging innovation and creativity, individually considering followers needs and issues [22]. Openness to Experience has also been found to significantly correlate with transformational leadership components [20, 21]. Kaiser and

Hogan [23] have provided evidence that adjustment, a concept related to emotional stability, is positively associated with enabling leadership (interpersonally oriented), but was not related to task-oriented behaviors [24]. In the most recent meta-analysis DeRue et al. demonstrated that agreeableness and extraversion predicted considerate leadership behaviors, which reflected interpersonal orientation of the leader [24]. DeRue et al. have also provided evidence, in agreement with earlier research, that conscientiousness is positively related to task-oriented behaviors [24] and supported previous findings [25] that it exhibits greatest consistency in predicting leadership effectiveness. In all, recent meta-analyses on relationships between leadership styles and the five-factor model of personality demonstrate that traits, which mostly determine leadership behavior, are conscientiousness [24], extraversion and agreeableness [19, 20]. We believe, that these results shall be examined again in the context of diagnosing differences in leadership profiles considered as heterogeneous behavioral units.

3 Method

3.1 Participants and Procedure

Two self-report questionnaires for assessing leadership styles and personality were simultaneously administered during pre-arranged meetings with 477 Polish managers from various organizations. Fully completed leadership styles questionnaires were returned by 477 managers—a 100 % response rate. Personality questionnaires were completed by 333 managers—a 69.8 % response rate. The mean age of the participants for the larger sample was 40.39 (SD = 10.03) and 41.53 (SD = 10.29) for the smaller one. There were 145 women and 332 men in the larger sample and 218 men and 115 women in the smaller one. In the 477-participant sample, presidents, vice-presidents, and managing directors accounted for 29.4, 23 % were middle managers, and 47.6 % were first line managers. In the 333-participant sample, vice-presidents and managing directors accounted for 29.7, 21 % were middle managers, and 49.2 % were first line managers. Mean work experience was 15.53 years (SD = 9.22) and 16.54 years (SD = 8.82) for the 477-participant sample and 333-participant sample, respectively.

3.2 Measures

Leadership styles. Leadership behavior was measured with a 51-item *Managerial Styles of Leading* (MSL) questionnaire, which was developed using a Polish sample (CFA model: χ^2/df = 1.97; p = 0.001; RMSEA = 0.05; GFI = 0.84; AGFI = 0.82)

[6]. The MSL consists of six scales: Structuring style represents goal oriented and cooperative behaviors; controlling style represents disciplining and autocratic behaviors participative style represents joint decision-making and cooperative behaviors;. Machiavellian style represents manipulative behaviors; rewarding style represents focusing on achievements and rewarding behaviors; distant style represents withdrawn and unconcerned style of managing. Items are answered on a five-point Likert scale with answers ranging from 'definitely applies to me' to 'doesn't apply to me'. In the present study, Cronbach's alpha of the MSL subscales ranged from 0.61 to 0.82. This scale has demonstrated good construct validity [6].

Personality traits. To measure five personality traits, we used the Polish adaptation of the 60-item NEO-FFI questionnaire [26], including five subscales: (1) Extraversion encompasses sociability, activity, and the tendency to experience positive emotions; (2) Neuroticism embraces anxiety, anger hostility, depression, impulsiveness, self-consciousness, and vulnerability; (3) Openness to experience includes imagination, flexibility, creativity, and curious intellect, openness to values and cultural differences, interest in arts and aesthetic sensitivity; (4) Agreeableness represents such tendencies as being cooperative, trusting, tolerant, compliant, and sympathetic; (5) Conscientiousness represents a tendency to be achievement oriented, self-disciplined, well organized, cautious, and deliberate. Items were answered on a five-point Likert scale ranging from 'strongly disagree' to 'strongly agree'. In the current sample, Cronbach's alphas for these factors ranged from 0.65 to 0.82 (see Table 1). These results generally reflect the normative data [26]. There is evidence for cross-cultural validity of the NEO-FFI Inventory [27].

Analytic procedures. To test Hypothesis 1 (*H1*) and Hypothesis 2 (*H2*) we attempted to generate typology of leaders on the basis of empirically derived scales, which measure leadership styles (MSL). First, We conducted hierarchical cluster analysis and decided to explore four-cluster solution on the basis the dendrogram, the agglomeration schedule coefficients, and the interpretability of the cluster solution [28]. Then, we performed cluster analysis using *k*-means procedure on the standardized *z* scores for the MSL scales. *K*-means method allowed extracting from the data clusters with minimum variability within clusters and maximum variability between clusters [29]. Hypothesis 3 (*H3*) was tested using multivariate analysis MANOVA, in which personality traits were entered as dependent variables and leadership profiles as the independent variables.

4 Results

Table 1 reports descriptive statistics, internal consistency estimates and intercorrelations between all measured variables. The strongest significant correlation was observed for structuring and controlling leadership styles and the weakest significant correlation was for Machiavellian and participative leadership styles.

Table 1 Mean, standard deviations and Pearson's correlations for all variables

	M	SD	1	2	3	4	5	6	7	8	9	10	11
1	26.51	8.12	**0.82**										
2	45.33	5.95	−0.39**	**0.72**									
3	40.24	6.62	−0.21**	0.31**	**0.65**								
4	43.25	5.71	−0.21**	0.24**	0.16**	**0.66**							
5	47.74	5.10	−0.39**	0.41**	0.16**	0.19**	**0.77**						
6	49.17	5.66	−0.11	0.24**	0.06	0.03	0.39**	**0.79**					
7	22.28	4.73	0.20**	−0.03	−0.27**	−0.14*	0.16**	0.47**	**0.68**				
8	21.49	3.54	−0.01	0.32**	0.13*	0.16**	0.21**	0.26**	0.09	**0.62**			
9	27.71	6.98	0.23**	−0.01	−0.13	−0.41**	−0.06	0.14**	0.32**	−0.11*	**0.74**		
10	23.53	3.62	−0.16**	0.34**	0.23**	0.08	0.26**	0.37**	0.17**	0.39**	−0.01	**0.64**	
11	22.54	5.10	0.33**	−0.15**	−0.29**	−0.08	−0.18**	−0.14**	0.22**	0.06	0.31**	−0.08	**0.61**

Note [a]$N = 333$,[b]$N = 477$. *$p < 0.05$ (2-tailed); **$p < 0.01$ (2-tailed). Diagonal replaced with Cronbach's alpha (*bold values*)

1. Neuroticism[a], 2. Extraversion[a], 3. Openness to experience[a], 4. Agreeableness[a], 5. Conscientiousness[a], 6. Structuring style[b], 7. Controlling style[b], 8. Participative style[b], 9. Machiavellian style[b], 10. Rewarding style[b], 11. Distant style[b]

4.1 Leadership Profiles—Cluster Analysis Results

In the cluster analysis, alternative results for a different number of clusters were examined with a focus on the means for each cluster on each dimension. Finally four clusters were retained: (1), the four leadership clusters were retained: (1) Pseudo-supervisors (n = 103; 21.6 %, 31 females and 72 males), (2) Machiavellians (n = 116; 24.3 %, 32 females and 84 males), (3) Natural leaders (n = 125; 26.2 %, 50 females and 75 males) and (4) Pseudo-democrats (n = 133; 27.9 %, 32 females and 101 males). Figure 1 presents a plot of the cluster centers for each of the clusters, further referred to as leaders' types. The assigned labels for leaders' types are based on the particular configuration of leadership styles in a given cluster

Pseudo-supervisors scored the lowest among the four groups in structuring, participative, and rewarding leadership styles, were slightly below average on controlling and moderate on Machiavellian and distant styles. Machiavellians scored the highest in controlling, Machiavellian, and distant styles and above average in structuring, participative, and rewarding styles. Natural leaders obtained the highest scores on structuring and rewarding styles, above average scores on controlling and participative styles, below average scores on Machiavellian style, and had the lowest score on distant style. Pseudo-democrats obtained the lowest scores on controlling and Machiavellian styles, moderate scores on participative, rewarding and distant styles, and low scores on structuring style.

4.2 Personality Differences of Leadership Profiles

Table 1 reports descriptive statistics, internal consistency estimates for the MSL and NEO-FFI questionnaires, and intercorrelations between all variables. All

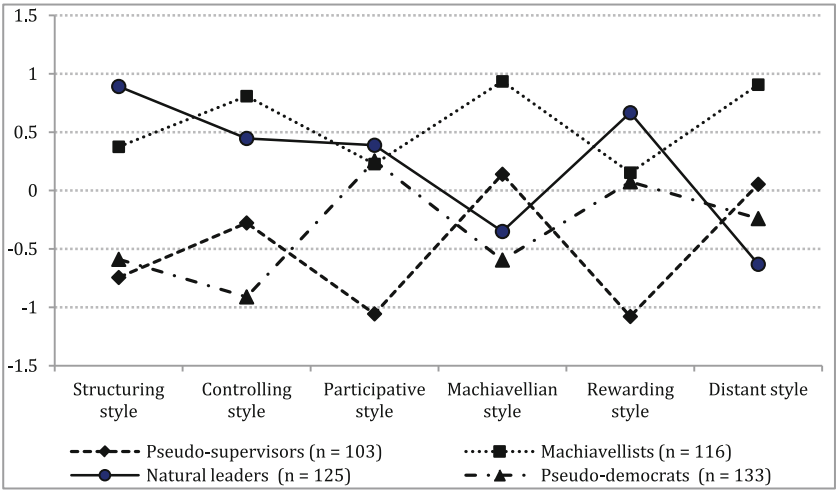


Fig. 1 Mean standardized scores of leadership styles for four leader clusters

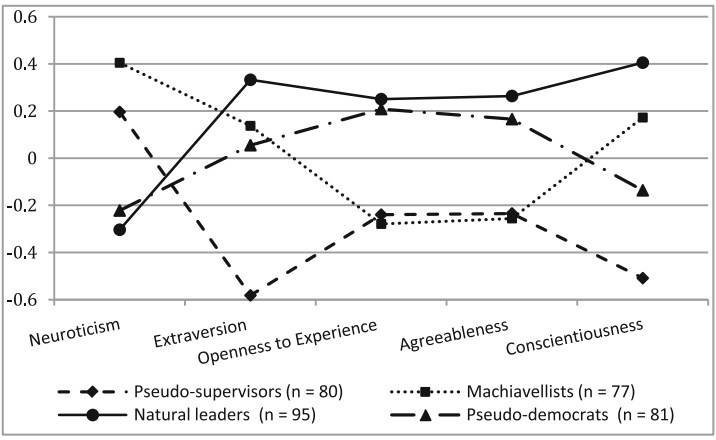


Fig. 2 Mean standardized z scores of personality traits for leadership profiles

correlations among leadership styles and personality traits were small to moderate. Structuring style significantly correlates with extraversion and conscientiousness. Controlling style is significantly related to high neuroticism, high conscientiousness, low openness and low agreeableness. Participative style significantly correlates with extraversion, openness, agreeableness and conscientiousness. Machiavellian style significantly correlates with high neuroticism and low agreeableness. Rewarding style significantly correlates with high extraversion, openness, conscientiousness and low neuroticism. Distant style is significantly associated with low extraversion, openness, conscientiousness and high neuroticism. The following analysis is focused on identifying dominant personality traits in each of the four leadership profiles. In the present analysis, mean leadership clusters were extracted by entering the initial clustering centers into a new matrix. Intergroup distances among the means of the initial clusters were recalculated, which resulted in retaining four clusters. Figure 2 presents a plot of the mean z scores of personality traits in cluster centers for the four leadership profiles.

Results of the MANOVA analysis indicate significant differences between leadership profiles for all personality traits (Wilk's lambda = 0.70; $F(3.329) = 8.29$, $p < 0.001$, partial $\eta^2 = 0.11$). Table 2 reports mean standardized scores of the personality measures, MANOVA results, and Tukey's HSD post hoc comparisons.

As shown in Fig. 2, Pseudo-supervisors scored the lowest on extraversion and conscientiousness, slightly below average on openness to experience and agreeableness, and slightly above average on neuroticism. Machiavellians scored the highest on neuroticism, slightly above average on extraversion and conscientiousness, and slightly below average on openness to experience and agreeableness. Natural leaders scored higher than the remaining three cluster groups on

Table 2 Descriptive statistics and comparisons of personality traits across leadership profiles

	a		b		c		d		Partial		Post hoc
	M	SD	M	SD	M	SD	M	SD	$F_{(3,329)}$	η^2	
1	0.20	0.95	0.40	0.91	−0.30	1.02	−0.22	0.95	10.28***	0.09	a > b, c; b > c, d
2	−0.58	0.95	0.14	0.87	0.33	0.97	0.05	0.97	14.73***	0.12	a < b, c, d; c > d
3	−0.24	0.92	−0.28	0.85	0.25	1.00	0.21	1.11	7.05***	0.06	a, b < c, d;
4	−0.23	0.80	−0.26	1.13	0.26	0.95	0.17	1.00	6.39***	0.06	a, b < c, d
5	−0.51	0.97	0.17	0.86	0.41	0.87	−0.14	1.06	15.07***	0.12	a < b, c, d; b, c > d

Note ***$p < 0.001$. a. Pseudo-supervisors; b. Machiavellians; c. True leaders; d. Pseudo-democrats; 1. Neuroticism, 2. Extraversion, 3. Openness to experience, 4. Agreeableness, 5. Conscientiousness

extraversion, conscientiousness, openness to experience, and agreeableness and lower on neuroticism. Pseudo-democrats scored slightly below average on neuroticism and conscientiousness, slightly above average on openness to experience and agreeableness, and average on extraversion.

5 Discussion

5.1 Heterogeneity of Leadership Behaviors—Leadership Profiles

In this study, we first postulated the heterogeneity of leadership styles expressed in a behavioral configuration of leadership profiles. Each of the four leadership profiles has particular characteristic and different pattern of dominating leadership styles. The profile of Pseudo-supervisors is defined by a moderate degree of Machiavellian and distant styles. It indicates a low concern for task completion and solving organizational problems. Machiavellians' profile is dominated by controlling, Machiavellian, and distant styles of leadership. Such behavioral configuration demonstrates focus on maintaining discipline, efforts directed towards accomplishing personal goals but little interest in followers' work results and performance. Natural leaders use structuring and rewarding styles as their dominant behavioral units. They are mostly characterized by active monitoring of followers' work assignments, predicting potential mistakes and errors, and enthusiastic concern for adequate rewarding. Pseudo-democrats' profile of leadership is dominated by a low degree of structuring, controlling and Machiavellian styles. It may indicate

that Pseudo-democrats tend to avoid active monitoring of followers' progress with assignments, withdraw from taking corrective actions and neglect disciplining.

In sum, we have supported our first Hypothesis (*H1*) that leadership profiles consist of patterns of leadership behaviors, such that each profile is characterized by a different configuration of dominating leadership styles. Also, the above results demonstrate, supporting our second Hypothesis (*H2*), that configuration of leadership styles, i.e. leadership profiles, go beyond two-dimensional pattern of task- and follower-orientation.

5.2 *Inside Leadership Profiles—Dominating Personality Traits*

Our second intention in this study was to determine the personality differences in leadership profiles. As presented in Fig. 2, Pseudo supervisors' pattern of personality traits indicates a tendency for avoiding interpersonal relationships, weak motivation to achieve goals, somewhat uncooperative and rather simplistic, narrow-minded understanding of the surrounding reality [18]. This configuration of traits may imply that general anxiety, avoidance, and manipulation underlie these specific leadership styles. Machiavellian leaders have elevated neuroticism, extraversion and conscientiousness. It may suggest that they act impulsively, overly emotional, but tare attentive to tasks and people. The pattern of personality traits of Natural leaders represents well-organized, active, and emotionally stable individuals with the ability to experience and express positive emotions, balanced, with positive attitudes towards new experiences and concern for others [18]. Natural leaders may be described as individuals with high self-esteem, who are dominant, willing to control the surrounding reality, yet relaxed and sociable. The personality pattern of Pseudo-democrats indicates that they may be relatively calm, open-minded and cooperative, modestly sociable, and somewhat less disciplined and less organized. Pseudo-democrats can be thought of as easy-going persons, unconcerned with completion of tasks, generally relaxed and nice to be with, but without a sense of direction. It seems that Pseudo-democrats' leadership style has an adaptive nature and is rooted in rather stable and balanced personality profile.

In sum, the obtained personality patterns of leaders with specific leadership profiles are varied. Personality patterns of an individual leadership profile correspond to the configuration of leadership styles within that profile. In other words, leadership profiles indicate psychological consistency. Our third Hypothesis (*H3*) has thus been supported. It allows taking a broader perspective in defining and interpreting the heterogeneity of leadership profiles. One of the possible lines of interpretation is that the identified leadership profiles of Pseudo-supervisors, Machiavellians, Natural leaders, and Pseudo-democrats could further be classified as functional and dysfunctional leadership. Trait and behavioral configuration of Pseudo-supervisors and Machiavellians may be considered as conceptually close to

various forms of dysfunctional, destructive, toxic, or abusive leadership [4, 30]. Any form of harmful leadership can have negative effects on various elements of organizational systems, such as psychological well-being of subordinates [30], productivity [31], or even organizational decline and downsizing [32]. Among four leadership profiles, only Natural leaders may be thought of as an exemplary managerial profile of personality. Obviously, we cannot infer exactly which leadership personality profile would be most effective, but on the basis of earlier personality and situational adjustment research [18] we may assume that the Natural leaders' profile is best suited to perform well in leadership situations.

6 General Discussion

In our study we found that leadership profiles are not homogenous, rather they represent configurations with differing levels of frequencies of particular components. Previous findings on leadership styles considered as dimensions are of great value, but the profile approach seems to be more useful in explaining leadership behavior and its correlates. The concept of a profile assumes that leadership styles do not occur in an isolated form, they are rather configurations of behaviors, which enhances their regulatory power.

We have shown in this study that every profile includes its particular dominating leadership styles. Through verifying differences in configurations of personality traits in each of the profile, we've also proven that they are psychologically consistent. We think that effective leadership requires some ability to utilize various kinds of behavioral styles in a given situation. In this study, we demonstrated that leadership styles and personality traits of managers labeled here as Natural leaders might be considered an exemplary diagnostic pattern in managerial research.

Investigating leadership behaviors from the perspective of the configuration of different styles of leading is somewhat closer to genuine managerial behaviors in authentic leadership situations. As we've mentioned in the Introduction, the classic two-tier approach to studying leadership styles does not fully reflect real behaviors. This approach is a good starting point to further analyze leadership behaviors in complex circumstances of leading people in organizations.

6.1 Implications for Practice

In leadership literature primary attention is given to leader traits, among which personality has been the major and ever-current focus [23, 24]. In this study, extraversion, conscientiousness and neuroticism exhibited the strongest significant relationship with leadership profiles. Results of this analysis show some similarities to what has been found in other studies so far [21, 24, 33]. In the current research extraversion demonstrated the strongest negative relation with Pseudo-supervisor

leadership profile and positive relationship with a Natural leader profile. Pseudo-supervisors represent leaders who demonstrate weak abilities to organize and direct actions in pursuit of goals. Such pattern of psychological mechanisms is certainly a dysfunctional one and may negatively influence subordinates, decision processes, and task completion. Pseudo-supervisors probably shall not be selected to managerial positions nor promoted to take on strategic leadership roles. This research study, similarly to numerous other studies [24], has demonstrated positive relationships of consciousness and extraversion with fundamental leadership behaviors oriented towards achieving goals and maintaining good social environment among followers. In this study it may be assumed that Natural leaders are the ones who are best suited to take on the leadership position and serve as a role model for their subordinates.

In addition, given future validation studies of the MSL questionnaire, assessment of leadership behavioral and personality profiles for selection and/or advancement may have been based on the most current, culturally adjusted leadership style questionnaire. Particular leadership profiles, named here Pseudo-democrats, Pseudo-supervisors and perhaps Machiavellian, may not be desirable in most leadership situations. Early diagnosis of such tendencies would reduce the possibility of selecting or promoting individuals with potentially destructive behavioral tendencies. Also, it seems essential to repeatedly verify managerial leadership expressions for they are changing and becoming more diversified along with conditions influencing leadership.

6.2 Limitations

The results of our study are subject to several limitations. Our results may be contaminated by same source bias referred to as common method variance (CMV) [34], which apparently raises concerns and is reported to be a pervasive problem in organizational research [35]. The problem posed by method variance relates to inflating or reducing estimates of relationships between constructs under study, but mostly, the literature attention has been directed to shared method variance producing an upward bias in correlations between variables [36]. In this study, to assess the CMV [35, 37] the Harman's single factor test was used. In this method all items from the constructs measured are entered into an exploratory factor analysis to see if one single factor will emerge or if one factor will account for the majority of covariance in the variables [35]. After conducting an unrotated factor analysis on the present data, four distinct factors emerged with eigenvalues greater than 1.0, and these four factors accounted 64.8 % of the total variance. Also, second unrotated factor analysis, where the number of factors were restricted to 1, revealed that the single factor accounted for 25.7 % of the total variance. These results suggest that the shared variance does not threaten greatly the results of this study and allow drawing justifiable interpretations and conclusions.

References

1. Fiedler, F.E.: Personality, motivational systems and the behavior of high and low LPC persons. Hum. Relat. **25**, 391–412 (1971)
2. Ross, L., Nisbett, R.E.: The Person and the Situation: Perspectives of Social Psychology. McGraw-Hill, New York (1991)
3. Einarsen, S., Aasland, M.S., Skogstad, A.: Destructive leadership behavior: A definition and conceptual model. Leadership Quart. **18**, 207–216 (2007)
4. Shaw, J.B., Erickson, A., Harvey, M.: A method for measuring destructive leadership and identifying types of destructive leaders in organizations. Leadership Quart. **22**, 575–590 (2011)
5. Epstein, S.: Explorations in personality today and tomorrow: a tribute to Henry A. Murray Am. Psychol. **34**, 649–653 (1979)
6. Babiak, J.: Polish Managers' Leadership Styles: Developing and Validating the Managerial Styles of Leading Questionnaire. Pol. J. Appl. Psychol. **12**, 41–64 (2014)
7. Bass, B.M.: Bass and Stogdill's Handbook of Leadership. Theory, Research, and Managerial Applications. The Free Press, New York (1990)
8. Bass, B.M., Bass, R.: The Bass Handbook of Leadership: Theory, Research, and Managerial Applications, 4th edn. The Free Press, New York (2008)
9. Bono, J.E., Shen, W., Yoon, D.J.: Personality and leadership: looking back, looking ahead. In: Day, D. (ed.) The Oxford Handbook of Leadership and Organizations, pp. 199–218. Oxford University Press, New York (2014)
10. Bajcar, B., Babiak, J., Nosal, C.S.: When leaders become strategists: a new look at the determinants of leadership styles through their relationship with strategic thinking. Proc. Manuf. **3**, 3669–3676 (2015)
11. Stogdill, R.M.: Handbook of Leadership. A Survey of Theory and Research. The Free Press, New York (1974)
12. Yukl, G.: Leadership in Organizations. Pearson Education Inc., Upper Saddle River (2006)
13. Tannenbaum, A.S., Schmitt, W.H.: How to choose a leadership pattern. Harv. Bus. Rev. **36**, 95–101 (1958)
14. Fleishman, E.A.: The measurement of leadership attitudes in industry. J. Appl. Psychol. **37**, 153–158 (1953)
15. Misumi, J., Peterson, M.F.: The performance maintenance theory of leadership: review of a Japanese research program. Admin. Sci. Quart. **30**, 198–223 (1985)
16. House, R.: A path goal theory of leader effectiveness. Admin. Sci. Quart. **16**, 321–338 (1971)
17. Hogan, R., Hogan, J.: Assessing leadership: a view from the dark side. Int. J. Sel. Assessment **9**, 40–51 (2001)
18. Costa Jr., P.T., McCrae, R.R.: Domains and facet: hierarchical personality assessment using the Revised NEO Personality Inventory. J. Pers. Assess. **64**, 21–50 (1995)
19. Bono, J.E., Judge, T.A.: Personality and transformational and transactional leadership: a meta-analysis. J. Appl. Psychol. **89**, 901–910 (2004)
20. Judge, T.A., Bono, J.E.: Five-factor model of personality and transformational leadership. J. Appl. Psychol. **85**, 751–765 (2000)
21. Ployhart, R.E., Lim, B.C., Chan, K.Y.: Exploring relations between typical and maximum performance ratings and the five factor model of personality. Pers. Psychol. **54**, 809–843 (2001)
22. Bass, B.M., Riggio, R.E.: Transformational Leadership. Lawrence Erlbaum Associates, Mahwah (2006)
23. Kaiser, R.B., Hogan, J.: Personality, leader behavior, and overdoing it. Consult. Psychol. J. **63**, 219–242 (2011)
24. DeRue, D.S., Nahrgang, J.D., Wellman, N., Humphrey, S.E.: Trait and behavioral theories of leadership: a meta-analytic test of their relative validity. Pers. Psychol. **64**, 7–52 (2011)

25. Barrick, M.R., Mount, M.K., Judge, T.A.: Personality and performance at the beginning of the new millennium: what do we know and where do we next? Int. J. Sel. Assess **9**, 9–30 (2001)
26. Zawadzki, B., Strelau, J., Szczepaniak, P., Śliwińska, M.: Inwentarz Osobowości NEO-FFI Costy & McCrae. Adaptacja Polska. Podręcznik. [NEO-FFI Inventory of Costa and McCrae. Polish adaptation. Manual]. Pracownia Testów Psychologicznych PTP, Warszawa (1998)
27. McCrae, R.R., Costa Jr., P.T., Hrebickova, M., Urbanek, T., Martin, T., Oryol, V.E., Senin, I. G.: Age differences in personality traits across cultures: self-report and observer perspectives. Eur. J. Pers. **18**, 143–157 (2004)
28. Aldenderfer, M.S., Blashfield, R.K.: Cluster Analysis. Sage Press, Beverly Hills, CA (1984)
29. Magidson, J., Vermunt, J.K.: Latent class models for clustering: a comparison with K-means. Can. J. Market. Res. **20**, 37–44 (2002)
30. Tepper, B.J.: Consequences of abusive supervision. Acad. Manag. J. **43**, 178–190 (2000)
31. Keelan, E.: Bully for you. Accountancy **125**, 56 (2000)
32. Carmeli, A., Sheaffer, Z.: How leadership characteristics affect organizational decline and downsizing. J. Bus. Ethics **86**, 363–378 (2009)
33. Judge, T.A., Bono, J.E., Ilies, R., Gerhardt, M.W.: Personality and leadership: a qualitative and quantitative review. J. Appl. Psychol. **87**, 765–780 (2002)
34. Campbell, D.T., Fiske, D.W.: Convergent and discriminant validation by the multitrait-multimethod matrix. Psychol. Bull. **56**, 81–105 (1959)
35. Podsakoff, P.M., MacKenzie, S.B., Lee, J.Y., Podsakoff, N.P.: Common method biases in behavioral research: a critical review of the literature and recommended remedies. J. Appl. Psychol. **88**, 879–903 (2003)
36. Conway, J.M.: Method variance and method bias in industrial and organizational psychology. In: Rogelberg, S.G. (ed.) Handbook of Research Methods in Industrial and Organizational Psychology, pp. 344–365. Blackwell Publishing Ltd., Oxford (2004)
37. Lindell, M.K., Whitney, D.J.: Accounting for common method variance in cross-sectional designs. J. Appl. Psychol. **86**, 114–121 (2001)

A Study of the Current Status of Diversity Faultlines in Japanese Work Organizations

Takumi Iwaasa, Naoto Shoji and Motoki Mizuno

Abstract Managing people from different backgrounds has brought great benefits to work organizations. However, previous research has shown that diversity may have negative effects on performance because of diversity "faultlines", hypothetical dividing lines that may split a group into subgroups. We conducted an empirical study on faultlines for the first time in Japan to investigate the present status of faultlines and to assess the degree to which workers perceive that (certain) attributes (e.g. nationality, ethnicity, age, personality, attitude) may have an impact on the emergence of faultlines in Japanese work organizations. It has been shown that task-related attributes such as specialty and ability/knowledge are great factors affecting faultlines, and that every participant perceives faultlines based on such attributes as specialty, personality, and attitude.

Keyword Diversity management · Faultlines · Demographic related attributes · Task related attributes

1 Introduction

The term "diversity" refers to differences and similarities across various dimensions such as race, religion, gender, sexual preference, age, profession, organizational tenure and so on. Diversity further includes managing differences not only in diverse human resources, but also differences in diverse working styles such as full-time employment geographically confined, short-time regular employment, and teleworking employment.

In Japan, the importance of diversity is widely recognized in medical and sport organizations as well as business organizations because of the environment change in social climate, a declining birthrate, a growing proportion of elderly people, and diversification of individual values. The most severe problem is the decrease in the

T. Iwaasa (✉) · N. Shoji · M. Mizuno
Graduate School of Health and Sports Science, Juntendo University, Chiba, Japan
e-mail: tiwaasa@gmail.com

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labor force population. Numbers of workforce were around the 81 million mark until 1995 when they started decreasing, reaching about 78 million in 2014 and expected to have a half of those at present eventually. The Japanese government states that diversity management is a key strategy for human resources intended as part of management strategies by enterprises to build a competitive advantage. By exhibiting the diverse capabilities of human resources in management, the base for utilization of human resources will be expanded and linked to responses to diverse market needs to make use of various perspectives, and create the innovation that makes use of those differences. In fact, managing people from different backgrounds has brought great benefits to work organizations. In the past 40 years, however, research on diversity management has been conducted to examine the complex relationship between diversity and performance. The actual findings on the effects of diversity on performance have been relatively inconsistent. As portrayed diversity is a double-edged sword, diversity have both positive and negative aspects. Lau and Murnighan [4] proposed the term faultlines refer to hypothetical dividing lines that may split a group into subgroups based on one or more attributes. Faultline theory explains how the combination and configuration of the attributes of team members can influence the team's behavior and ultimately its performance (Fig. 1).

Adopted from Gratton et al.: Bridging faultlines in diverse teams. MIT Sloan Management Review, 2007; 48: 22–29.

We conducted an empirical study on faultlines for the first time in Japan to investigate the current status of faultlines and to assess the degree to which workers perceive that (certain) attributes (e.g. nationality, ethnicity, age, personality, attitude) may have an impact on the emergence of faultlines in Japanese work organizations.

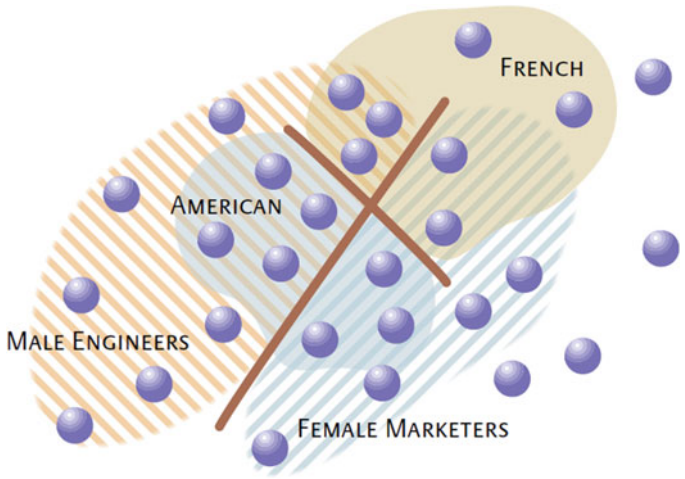


Fig. 1 The emergence of faultlines

2 Methods

Data were collected from 132 workers on streets in the center of Tokyo, Japan through an anonymous questionnaire. All the participants were Japanese workers who ranged in age 21–58. The questionnaire consisted of three sections, the first of which was a face sheet. The second section was a newly developed set of items designed to assess the degree to which participants perceived that attributes might have an impact on the emergence of faultlines (e.g. "How much do you think the differences among races will affect the emergence of faultlines?"), which was measured with four 4-point Likert questions, anchored from 1 = "Not at all" to 4 = "Extremely much". The third section explored participant's perception of faultlines in the present workplace (e.g. "Is there a hypothetical line that may split your team/organization into subgroups based on the difference in race?"), which was measured with Yes/No questions. In this study we employed 20 attributes listed in Table 1. The rows in Table 1 differentiate between readily-detected or surface-level diversity and underlying or deep-level diversity. Surface-level diversity is that which is easily observable or detectable. Age, sex, and ethnicity are examples of surface-level diversity. Deep-level diversity refers to differences among team members on attributes that generally become known only through interaction, such as personality, attitudes, and skills. Relation-oriented diversity refers to the distribution of attributes that are instrumental in shaping interpersonal relationships but which typically have no apparent direct implications for task performance; age, gender and personality characteristics are examples of relationships-oriented diversity. Task-oriented diversity refers to the distribution of attributes that are potentially relevant to team work. Organizational tenure, formal credentials and titles, and cognitive abilities are examples of task-oriented diversity.

Table 1 Taxonomy for describing the types of diversity

	Demographic/relationship-oriented attributes	Information/task-related attributes
Surface level	Age	Job position
	Sex	Tenure
	Ethnicity	Employment status
	Birth place	Work style
Deep level	Family make-up	Speciality
	Personality	Ability/knowledge
	State of health	Blood relationship
	Athletic experiences	Commitment to organization
		Learning style
		Communication style
		Work engagement
		Career anchor

Based on Jackson et al. [1], Joshi and Jackson [3], and Taniguchi [7]

3 Results

A total of 132 valid participants were Japanese workers who ranged in age 21–58 (M = 38.90 years SD = 9.81), 122 (92.42 %) were male, 10 (7.58 %) were female, 50 (37.88 %) were in administrative posts. Among the participants, the largest number of them were from Tokyo, followed by Kanagawa, Chiba, and Saitama prefecture. Categorized by size of the business, the proportion of the participants 26 (19.70 %) with 10–49 employees, followed by 12 (9.09 %) with 100–299 employees, and 12 (9.09 %) with 300–499 employee. The participants had a mean tenure of 10.98 years (SD = 9.55). Participants' functional backgrounds were sales 99 (75.00 %), engineers 13 (9.85 %), and marketing and creative 9 (6.82 %). By industry the proportions were as follows; finance (18.18 %), services (9.85 %), and information and communications (9.85 %).

Figure 2 shows the current status of faultlines and the degree to which participants perceived that attributes might have an impact on the emergence of faultlines. Attributes as follow had a high level of impact on the emergence of faultlines; specialty (57.25 %), personality (54.20 %), attitude (51.91 %), ability/knowledge (48.85 %), position (46.92 %), most of which were categorized into task-related attributes. On the other hand, demographic attributes such as race and state of health had a low level of impact on faultlines; race (6.11 %), state of health(7.63 %),

attributes	FL Appered		score (1-4)		Influence of FL
	n	%	1-4	SD	min max
age	42	32.3%	2.07	1.07	
sex	47	35.9%	2.04	1.09	
race	8	6.1%	1.66	1.01	
family make-up	13	9.9%	1.42	0.78	
hometown	32	24.6%	1.73	1.05	
blood relationship	26	19.8%	2.02	1.22	
tenure	57	43.5%	2.25	1.14	
position	61	46.9%	2.30	1.19	
employment status	51	38.9%	2.29	1.17	
attitude	68	51.9%	2.63	1.20	
communication style	49	37.4%	2.11	1.12	
work location	22	16.8%	1.85	1.12	
personality	71	54.2%	2.41	1.17	
ability/knowledge	64	48.9%	2.50	1.15	
values	39	30.2%	2.06	1.12	
learnig style	39	30.0%	2.14	1.14	
specialty	75	57.3%	2.54	1.19	
athletic experiences	22	16.8%	1.52	0.85	
state of health	10	7.6%	1.42	0.75	
work engagement	55	42.0%	2.32	1.16	

Fig. 2 The current status of faultlines

family composition (9.92 %). From the perspective of the impact on faultlines, the most influential factors were task-related attributes, to wit: attitude (2.63), specialty (2.54), ability/knowledge (2.50), personality (2.41), work engagement(2.32). In contrast to those results, demographic attributes had a low level of impact; family composition (1.42), state of health (1.42), athletic experiences (1.52), race (1.66), hometown (1.73). We found that task-related attributes such as specialty and ability/knowledge were great factors affecting faultlines, and that every participant perceived faultlines based on such attributes as specialty, personality, and attitude.

4 Discussion

This study is the first to have revealed the current status of faultlines in Japanese work organizations. Results on this study showed that all of the participants perceived some kind of faultlines in their workplace. Furthermore from the perspective of four dimensions that categorized the types diversity attributes. 22.14 % of the participants perceived surface level demographic/relationship-related attributes, 36.54 % of those perceived deeper level demographic/relationship-oriented attributes, 38.06 % of those perceived surface level information/task-related attributes, and 29.6 % of those perceived deep level information/task-related attributes. In other words, faultlines tended to be generated based on deeper level and task-related attributes. The result was contrary to previous study that have shown that demographic and easily detectable attributes such as sex and race have a tendency to affect the emergence of faultlines (e.g., [4–6]). This finding may be caused by four possibilities: (1) Due to a small amount of evidence. (2) a possibility due to not specifying the time axis, that is we did not mention the exact time when the participants perceived faultlines. Jehn et al. [2] mentioned that immediately discernible attributes becomes relevant to diversity outcomes, while age and gender diversity, characteristics that are readily apparent, become less relevant over time. (3) Due to the categorization of diversity attributes. We employed the categorization by Joshi and Jackson [3], but some researchers point that there is no reasonable consensus among researchers concerning a taxonomy for describing types of diversity attributes. (4) Due to a possibility that this finding is characteristics unique to Japan. It suggests that Japanese workers would be hospitable to nationality, race, gender and age. Further research is needed to improve the evidence level of this results.

5 Conclusion

This study also clarified the actual current status of faultlines in Japanese workplace. This study also indicates that demographic attributes would not be likely to have an influence on faultlines in Japan compared to European and US countries where previous study were conducted. The result in this study would be supportive

evidence the spirit of diversity and inclusion have come to pervade in Japan, regardless of nationality, race, ethnicity, religion, age, or gender. For team leaders, it is important to grasp the probability of faultlines emerging in their own organizations and so that leaders can significantly mitigate faultlines.

References

1. Jackson, S.E., Joshi, A., Erhardt, N.L.: Recent research on team and organizational diversity: SWOT analysis and implications. J. Manage. **29**, 801–830 (2003)
2. Jehn, K.A., Northcraft, G.B., Neale, M.A.: Why differences make a difference: a field study of diversity, conflict and performance in workgroups. Adm. Sci. Q. **44**(4), 741–763 (1999)
3. Joshi, A., Jackson, S.E.: Managing workforce diversity to enhance cooperation in organizations. In: West, M.A., Tjosvold, D., Smith, K.G. (eds.) International Handbook of Organizational Teamwork and Cooperative Working, pp. 277–296. Wiley, Hoboken (2003)
4. Lau, D.C., Murnighan, J.K.: Demographic diversity and faultlines: the compositional dynamics of organizational groups. Acad. Manag. Rev. **23**, 325–340 (1998)
5. Lau, D.C., Murnighan, J.K.: Interactions within groups and subgroups: the effects of demographic faultlines. Acad. Manage. J. **48**, 645–659 (2005)
6. Molleman, E.: Diversity in demographic characteristics, abilities and personality traits: do faultlines affect team functioning? Group Decis. Negot. **14**, 173–193 (2005)
7. Taniguchi, M.: Daibashiti Manejimento no Kenkyu: Tayoseiwo Ikasu Soshiki (Diversity Management: Organizational Utilization of Diversity). Hakutoshobo, Tokyo (2005) (in Japanese)

A Segmented Abstraction Hierarchy Model for Business Process Modeling

Arthur C. Jones

Abstract Business process modeling (BPM) typically focuses on the definition and refinement of standardized rules governing typical operations. The accommodation of extraordinary events is not usually addressed in BPM. A process model based on an abstraction hierarchy framework, however, could benefit by borrowing from the tools developed for ecologic interface design, which relies on underlying abstraction hierarchy models to provide adaptability in atypical conditions. In this work, a modified abstraction hierarchy model is proposed for application to general-purpose information systems. The new model explicitly includes both human and technologic components as an agent-based construct, and seeks to better define their interactions with data/information. The model is intended to act as a framework for guiding the development of robust business process models.

Keywords Abstraction hierarchies · Business process modeling · Business information systems · Process design · Systems design · Exception-handling · Process automation · Socio-technical systems

1 Introduction

The proposed application of various abstraction hierarchy models in the specification and refinement of business processes has been sporadic and often focused on very specific problem sub-sets. Rasmussen's original abstraction hierarchy model was developed to inform human-machine interface designs, which are focused on the transition between raw data and actionable information.

Extraordinary and novel situations present challenges to all decision-makers. Several overlapping bodies of literature address the needs of decision-makers and the decision-making process. Among these, Rasmussen's "abstraction-

A.C. Jones (✉)
Department of Supply Chain and Information Systems, Smeal College of Business, The Pennsylvania State University, University Park, State College, PA, USA
e-mail: ajones@smeal.psu.edu

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decomposition space" [1] stands out because of its explicit focus on complex socio-technical systems [2]. The inclusion of both "man and machine" as necessary components of each system is beneficial, even as the capabilities of information technologies improve and expand over time. Given that people will continue to maintain a position of privilege within such systems, and specifically within business information systems, it makes sense to develop process definition methods which take advantage of the dual aspects of the system architecture: allowing machines to relieve the cognitive workload of people during normal operations, but affording the ability for a person to step-in and direct activity when unusual circumstances arise.

The arts and sciences of defining and documenting business processes have evolved several generations within the past few decades, largely due to the influx of electronic data processing systems into the workplace. However, fixing the process definitions of either, or both, sides of socio-technical systems, as many business organizations are, will not necessarily lead to an optimized arrangement. Furthermore, the potential for interfering rather than complementary processes is often greatest when unusual circumstances occur. Machines can only handle the exceptions they have been designed to handle, whereas people are much more flexible with their ability to analyze a situation and make decisions. Well-designed systems should be able to utilize this flexibility, and perhaps even be able to recognize when it is needed.

The activities associated with business process modeling (BPM), business process analysis (BPA), and business process re-engineering or re-design (BPR) have expanded and become better defined in recent decades. To contrast these three related but distinct activities, I offer these short definitions: BPM is concerned with mapping the structure of a system by describing the constituent components and their relationships to one another. (BPM is analogous to anatomy and physiology in the medical professions.) BPA builds upon BPM by measuring the activities performed within and between the various parts of the system. (BPM would be similar to the science of pathology.) BPR utilizes both BPM and BPA to inform decisions on changing the current system into something more efficient. (The metaphor for BPR would be pharmacology and surgery.) BPM is the most fundamental of the set, and so the considerations affecting BPM can have tickle-down effects on the BPA and BPR.

2 Background

The design and development of business information systems has benefited by utilizing high-level views of business processes as the implementation of new or improved information system have been brought to bear on various problems and opportunities [3]. The software-centric Universal Modeling Language (UML) was adapted to better engage more of the entirety of the business process, and eventually contributed to the development of the Business Process Modeling Notation (BPMN) specifications [4]. Business Process Modeling Notation (BPMN) has since emerged as the standard for graphically representing not only the flow of activities

relating to a process, but may also show the decomposed hierarchical structure of the participating actors [5].

As the de facto standard, BPMN enjoys a sizeable community of users and several software packages that are able to integrate BPMN specifications. Some efforts have been made to provide translation methods allowing BPMN process specifications to be rendered as technologic artifacts beyond its initial meta-software intentions, e.g.: [6, 7]. Still, the use of BPMN is not without some added complexity and inherent ease-of-use issues [8–10].

The Abstraction Hierarchy (AH) model was introduced by Rasmussen as the "abstraction-decomposition space". The basic idea of an abstraction hierarchy is to provide a stable modeling framework for complex socio-technical systems [2]. The model's utility is that it can provide a static and scalable view of a dynamic system, and documents the "means-ends" relationships between the various components. These relationships are critical in systems which are composed of both technologic and human actors, as they define a set of goals toward which each actor should be contributing. Though the system's activities, and potentially its physical or informational structures, can change over time, the higher-level abstract goals do not change. This is what allows iterative improvement methodologies, such as the Living Laboratory approach [11], to be effective.

3 The Segmented Abstraction Hierarchy Model

The Information-Technology-People Abstraction Hierarchy model [12] was an earlier attempt to superimpose the composition of information systems onto the structure defined by Rasmussen's model. The genesis of this idea was that a high level, any information system can be decomposed into three basic classifications: the people who work within the system, the technology that is in use, and the data/information that is being manipulated. A distinction is made between data and information by defining data to be physical (e.g.: electrical flows, magnetic fields, pulses of light, audio pressure waves, etc.), whereas information was relegated to existence within an intelligent mind. Therefore, computers constitute data systems, which are only parts within an information system. Information systems must, by definition, include people.[1]

The I-T-P AH model was cumbersome. It required the consideration of the system's I-T-P decomposition from the very beginning. It was intended to support the development of one leg of the I-T-P at a time, while the other two were to act as support, which necessitated that they be fairly well define before the model could be

[1]These definitions of data and information allow for the future re-definition of "mind" if/when artificial intelligence systems are deemed worthy of that label. It also allows for the distinction between "brain" and "mind" as neurological parameters may be measured objectively, resulting in *data*, whereas thoughts might not.

utilized. Finally, the mapping of means-ends relationships across the space was not very easy to express effectively (Fig. 1).

Through several years of working with BPM techniques and languages, primarily UML and BPMN, the I-T-P AH model has been reformulated and refined to better represent the distinct "people" and "technology" aspects. The reorganization has also allowed the treatment of "information" to better represent the relationship of "data" and "information" as related, but distinct concepts, which are tied respectively more to technology and people. The decomposition data/information can be achieved via the mean-ends mappings of the various components within the abstraction-decomposition spaces for each leg. That is to say, the why-what-how relationships regarding decision-relevant information can be discerned by following the links, which can span between segments (Fig. 2).

Figures 3 and 4, represent two models of the same generic assembly-line process. The transition from one to the next is caused by the introduction of some new information technologies which will provide an enhanced level of automaticity. Allowing technology to handle more of the mundane maintenance activities involved with the process will free-up some of the time needed by the human parts of the system, but also alter the humans' role to be more inline with handing extraordinary circumstances rather than simply maintaining a state through minor adjustments.

Figure 3 shows a high-level process mapped into abstraction hierarchies for information systems and human resources segments of a system. The model shows the common purpose of the system, but also illustrates the separation of responsibilities between the human components and the information technology components

Figure 4 shows a modification of the system represented in Fig. 3 to utilize additional information technology resources, unloading some of the work of the human components. Note, though, that the overall process purpose has not been altered.

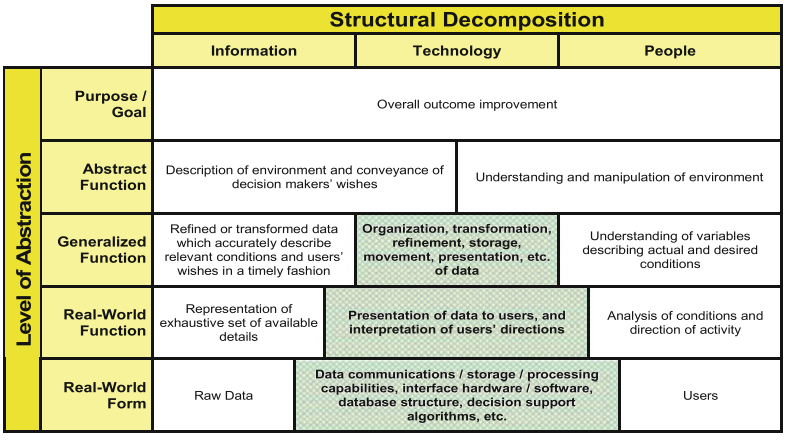


Fig. 1 General-purpose I-T-P abstraction hierarchy

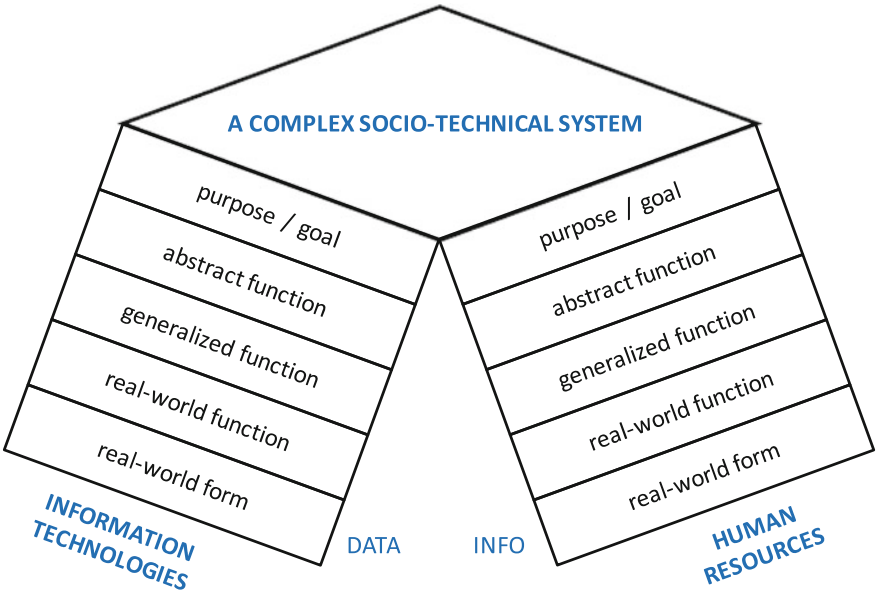


Fig. 2 a general-purpose segmented abstraction hierarchy model

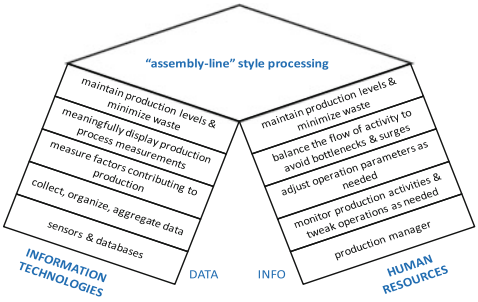


Fig. 3 A segmented AH model of a sample process

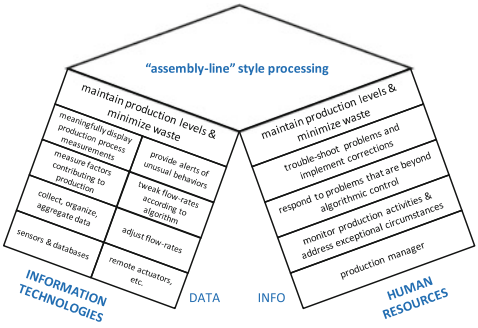


Fig. 4 A new model of the same process as in Fig. 3, but with more IT automation

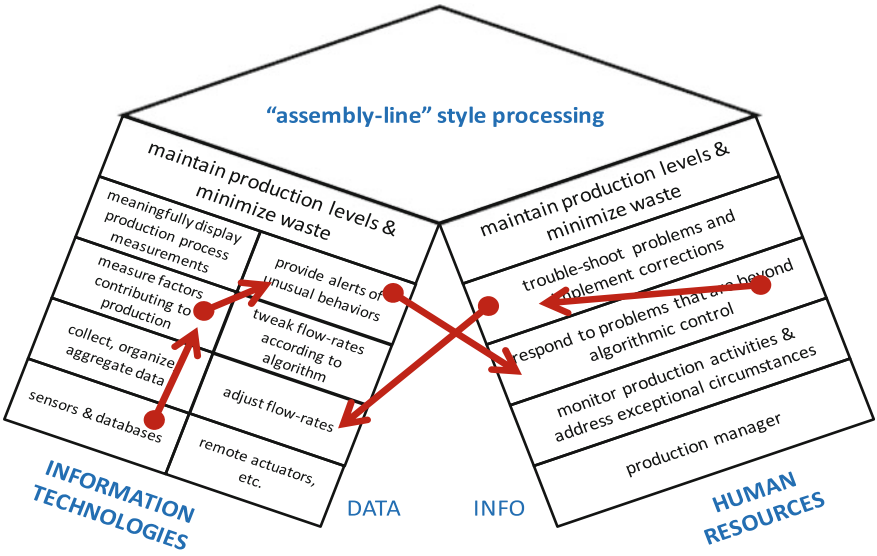


Fig. 5 Mapping why-what-how relationships between model components

Even though the system decomposition is broken across the two aspects of information technologies and human resources, they share the same overall goal or purpose within the system. Each leg of the model can represent a complete abstraction hierarchy, including the structural decomposition axis; something that was not very aesthetically workable with the I-T-P AH model.

Figure 5 shows one set of why-what-how linkages in the model after the addition of supplementary information technologies which allow for more automatic control. In this case, the link from the IT side to the HR represents a specific instance of information being provided to the user for a particular purpose. The history of this information, from its original capture as data, can be traced. The return link form the HR side to the IT side represents a specific affective need that must be built into the interface.

4 Summary

The segmented abstraction hierarchy model presented here may be of limited use within the grand scope of business process modeling, but it does have these advantages:

1. It is easy to understand once the fundamentals of Rasmussen's abstraction-decomposition space model are accepted. The separation of human and technologic components is a natural one for most designers, but this model keeps

those two sides in proximity so that they can be checked against one-another in the context of a single purpose and goal definition.
2. As information technologies improve and are more widely utilized in common processes, a cohesive model that can be used to map the changes in roles and responsibilities under a common purpose and goal definition could provide a platform from which systems designers can better plan the interaction between the human and technology sides, especially where the human is expected to do more exception-handling rather than normal-process oversight.

Future work will include developing methodologies for both completing the initial models as well as mapping the changes representing the shifts of activities between human and technology.

References

1. Rasmussen, J.: Information Processing and Human-Machine Interaction: An Approach to Cognitive Engineering, p. 228. Elsevier Science Inc. (1986)
2. Bisantz, A.M., Vicente, K.J.: Making the abstraction hierarchy concrete. Int. J. Hum. Comput. Stud. **40**(1), 83–117 (1994)
3. Aguilar-Savén, R.S.: Business process modelling: review and framework. Int. J. Prod. Econ. **90**(2), 129–149 (2004)
4. Russell, N., et al.: On the suitability of UML 2.0 activity diagrams for business process modelling. In: Proceedings of the 3rd Asia-Pacific conference on Conceptual modelling, vol. 53, pp. 5–104. Australian Computer Society, Inc., Hobart (2006)
5. Chinosi, M., Trombetta, A.: BPMN: an introduction to the standard. Comput. Stand. Interfaces **34**(1), 124–134 (2012)
6. Dijkman, R.M., Dumas, M., Ouyang, C.: Semantics and analysis of business process models in BPMN. Inf. Softw. Technol. **50**(12), 1281–1294 (2008)
7. Wong, P.Y.H., Gibbons, J.: Formalisations and applications of BPMN. Sci. Comput. Program. **76**(8), 633–650 (2011)
8. Wohed, P., et al.: On the suitability of BPMN for business process modelling. In: Dustdar, S., Fiadeiro, J.L., Sheth, A.P. (eds.) Business Process Management: 4th International Conference, BPM 2006, Vienna, Austria, 5–7 Sept 2006, pp. 161–176. Springer Berlin
9. Zur Muehlen, M., Recker, J.: How much language is enough? Theoretical and practical use of the business process modeling notation. In: Advanced Information Systems Engineering. Springer (2008)
10. Rosemann, M.: Potential pitfalls of process modeling: part A. Bus. Process Manag. J. **12**(2), 249–254 (2006)
11. McNeese, M.D., Perusich, K., Rentsch, J.R.: Advancing socio-technical systems design via the living laboratory. Proc. Hum. Factors Ergon. Soc. Annu. Meet. **44**(12), 2-610–2-613 (2000)
12. Jones, A.C., McNeese, M.D.: Cognitive fieldwork in emergency crisis management: developing the I-T-P abstraction hierarchy. Proc. Hum. Factors Ergon. Soc. Annu. Meet. **50** (3), 501–505 (2006)

Intuitive Number Evaluation Is not Affected by Information Processing Load

Zohar Rusou, Dan Zakay and Marius Usher

Abstract Numbers play a major role in decisions about vital life issues. This study compared the relative advantage of analytical vs. intuitive numerical processing in numerical average evaluations, while varying information load, complexity of the task and the information presentation formats. Thinking manipulation was based on Dehaene's [5] model, which postulates two pathways for the numerical processing. The complexity level of the task was manipulated by varying the number of items to be averaged. The information presentation format were simultaneous vs. sequential. When few numbers were presented, analytical evaluations were more accurate. When task complexity increased and a sequential presentation was used, intuitive evaluations were more accurate. The results challenge the common position that analytical thinking is always advantageous in numerical evaluations, suggesting instead that the relative efficiency of each thinking mode is mediated by task's factors. The cognitive mechanisms that might underlie our results are discussed.

Keywords Analytical thinking · Decision making · Dual process theories · Intuitive thinking · Numerical cognition

1 Introduction

Nowadays, the importance of numerical information processing in judgment and decision making is increasingly acknowledged by decision making researchers. Numerical information is ubiquitous in the decisions that guide our lives and

Z. Rusou (✉)
The Open University, Derekh Ha-Universita 1, 4353701 Ra'anana, Israel
e-mail: zoharrus@gmail.com

D. Zakay
Interdisciplinary Center (IDC) Herzliya, P.O.Box 167, 4610101 Herzliya, Israel
e-mail: dzakay@post.tau.ac.il

M. Usher
Israel Tel Aviv University, Ramat Aviv, 6997801 Tel Aviv, Israel
e-mail: marius@post.tau.ac.il

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decision quality depends critically on the ability to make effective numerical evaluations [1]. In the field of health—numerical information is almost impossible to avoid: ranging from the cholesterol content noted on a cereal box to the effectiveness of cancer treatments that is expressed as survival rates. Numerical value-integration is at the core of decision and evaluation processes [2]. Such processes are evident when we have to decide between (or evaluate) alternatives (e.g., apartments) that vary on a number of dimensions [3], or when we select between monetary rewards based on a series of returns [4]. The prevalence of numerical information in decision making—calls for the identification of strategies (or pathways) to improve the processing of numerical information.

Research in the field of numerical cognition suggests that there are two parallel and largely distinct number-processing pathways: (a) a symbolic pathway that is used for the sequential application of arithmetic operations, and (b) an implicit pathway, in which Arabic numerals are rapidly and automatically translated from their digital code into a quantity code on a "mental number line" and then processed in the same way as other physical magnitudes such as size or weight [5–7]. The notion of two processing pathways is broadly compatible with the distinction between analytical and intuitive thinking. The symbolic pathway is compatible with analytical thinking which is considered to be rule based, explicit and requiring a high working memory capacity, whereas the analog pathway is compatible with intuitive thinking, which is considered as occupying a position between the automatic operations of perception and deliberate reasoning, and as less demanding [8–15]. To illustrate the distinction between the two number-processing pathways—consider, for example, how people know how much time it takes them to drive home from work. One possibility is to calculate the driving time by summing the total time they spent driving, and then divide the total amount by the number of journeys (symbolic pathway). However, most people will not undertake such a calculation. Yet, after few driving experiences they develop a hunch on the average time it takes (implicit pathway.

The above contention of distinct analytical and intuitive number processing pathways raises the question of whether and when each thinking mode (pathway) is more likely to lead to better numerical processing [16]. The common stance among researchers is that, in numerical judgment tasks, the analytical thinking mode dominates [9, 17]. Even some researchers that advocate the intuitive mode of decision making, embrace this position and maintain that explicit analytical deliberation and strict adherence to rules are mandatory for symbolic numerical operations [9, 18]. The dominance of the analytical mode in numerical processing has been relatively unchallenged, as only few studies directly compared intuitive and analytical numerical evaluations [16], and most of the studies that have actually contrasted the two thinking modes on the same numerical evaluation tasks have found that analytical deliberation leads to more accurate evaluations [19–23]. Yet, some researchers highlight the importance of numeric intuition. For example, the Fuzzy Trace Theory (FTT) has directly challenged the supremacy of analytical numerical processing. According to FTT intuition (gist representations) is more

advanced developmentally compared to analytical thinking (verbatim representations) and that reliance on gist often seems to improve judgment and decision making when precise responses (e.g., point estimates) are not required [13, 24, 25]. Similarly, Peters et al. [1], asserts that mental-number-line representations seems to guide decision making. In line with these assertions, recent findings, demonstrate powerful and fairly accurate intuitive numerical evaluations [26–32].

The current study aims at examining whether the view that analytical deliberation is the optimal way to approach numerical judgment tasks is indeed warranted. A pilot study we conducted, suggests that this is not always the case. In our study, 26 participants were asked to evaluate the average value of a set of eighteen two-digit numbers, presented sequentially. Twelve participants were instructed to base their evaluations on numerical rules (i.e. analytically), and the others were instructed to form an impression of the magnitude of the numbers and base their evaluations on that impression, while avoiding the application of numerical rules (i.e. intuitively). The findings were that intuitive evaluations yielded better accuracy $M = 3.43$, $SD = 2.77$ than analytical evaluations $M = 7.75$, $SD = 6.72$ $t(24) = 2.20$, $p < 0.05$.

The outcomes of our pilot study call for the identification of potential factors that might give advantage to one of the thinking modes or the other. This call gains additional impetus by the recent demonstrations of the capability of the intuitive thinking mode to process numeric information. A prominent factor that was highlighted in the literature as influencing the relative efficacy of analytical versus intuitive judgments is cognitive load. The evaluation task given in our pilot study was characterized by high complexity level (due to the large set of numbers) and a sequential presentation of information ("one piece at a time"). Both Task's complexity and a sequential information presentation might engender information load.

1.1 The Information Load Engendered by the Task

A prevalent stance in dual process literature is that cognitive load tends to disrupt effortful analytical but not intuitive thinking [11]. Research has shown that cognitive load impairs rule based analytical strategies demanding high working memory capacity, but not intuitive strategies [33–36]. Although this evidence usually refers to cognitive load induced by concurrent competing tasks, information load engendered by the target task might also produce cognitive load and subsequently disrupt analytical judgments.

1.2 The Complexity Level of a Task

Analytical thinking requires access to a central working memory system of limited capacity, whereas intuitive thinking does not. The low capacity of the working

memory constrains analytical processing, making it less suitable for very complex judgments, while intuition can integrate large amounts of information into an evaluative summary judgment [10, 11, 17, 18, 29, 30]. The probability of making errors in deliberate analytical thought is a function of the complexity of the task. The greater the complexity a task exhibits in analytical terms (as measured, for example, by number of variables), the less likely it is that a person will both know the appropriate formula and apply it correctly [16]. In addition, for analytical evaluations, errors increase with the number of elements, due to accumulating errors in the application of the rules [36]. Interestingly, however, some of these researchers noted also that their findings do not hold for numerical problems and that tasks that require precision and strict following of rules are compatible with the analytical processing mode exclusively [17, 18]. Yet, our pilot study demonstrates that under high information load intuitive evaluations can outperform analytic numerical evaluations.

1.3 The Format of Information Presentation: Sequential Versus Simultaneous

Another characteristic of the evaluation task given in our pilot study, is the sequential presentation of information. Only few researchers referred to the question of the effect of sequential versus simultaneous information presentation on analytical and intuitive thinking, and the relevant evidence is ambiguous. Several researchers suggested that choices that are seen as sequential elicit a preference for analytical thinking, while choices that are seen as holistic are perceived as amenable with intuition [17, 29, 37, 38]. Other researchers have demonstrated that the effectiveness of analytical thinking depends not only on the availability of the relevant information, but also on the information's ease of process [39].

Nevertheless, we assume that the sequential presentation of information in our pilot study could have a detrimental effect on the analytical but not on the intuitive average evaluations. We believe that the source of difficulty engendered by the sequential presentation of the numbers is threefold. First, the rule based average calculation of sequentially presented numbers produces a dual task setting, by requiring participants to count the number of elements while computing their sum. Dual tasks tend to disrupt effortful analytical processes, but not effortless intuitive processes [11]. Second, a sequential presentation of the numbers increases the information load of the task by dictating the order in which the numbers have to be summed, thus preventing the use of effort reducing strategies such as coupling numbers that sum to a multiples of ten (such as coupling 27 and 33 that add up to 60). A third source of difficulty may stem from a lack of availability of information. The analytical calculation of averages involves two distinct processing stages: (1) Summation of the given numbers, (2) division of the total sum by the number of items. In the sequential condition, in the second stage of the calculation, the

information on the number of items is no longer available. That is, the structured nature of analytical thinking [10] and its dependence on the completeness of information [16], may explain why accuracy declines. In contrast, intuitive thinking has a unique capability to operate when only partial information is available and thus should not affected by the presentation format.

2 The Current Study

Based on our pilot study and the theoretical assertions described above, we assumed that the relative advantage of the two thinking modes in numerical evaluations is dictated by the information load that is engendered by the complexity level of the task and the format of information presentation. We assumed that (1) when under low information load (task involving fewer numbers, easy calculation and a simultaneous presentation of the information) analytical evaluations will be more accurate, but high information load (engendered by increased task complexity, and a sequential presentation of the information) would yield an advantage for intuition, (2) a sequential presentation of the information will impair analytical evaluation but not intuitive evaluations and (3) increased task complexity will hinder the quality of analytical evaluations but not of intuitive evaluations.

To test our hypotheses, we pitted intuitive and the analytical number processing pathways against each other on the same numerical averaging tasks. In two experiments, participants were presented with sets of two-digit numbers, and were asked to evaluate the average value of each set. In a factorial design, instructions aimed to stimulate either more intuitive or more analytical thinking were given, and information load was manipulated. The manipulation of information load was done by varying task complexity (the number of elements in the set and the complexity of the computation) and information presentation format (simultaneous vs. sequential) were manipulated. To assess performance on the tasks, the accuracy of the evaluations was calculated by computing the absolute deviations of participants' evaluations from the actual average value of the numbers.

3 Experiment 1

Experiment 1 aimed at examining the effect of the information load (that is engendered by the information presentation format- simultaneous vs. sequential) on the relative advantage of the two thinking modes. In this experiment, sequences of 18 numbers were presented either simultaneously or sequentially.

4 Method

Participants. Twenty-eight undergraduate students from the Interdisciplinary Center (IDC) in Herzliya, Israel were randomly assigned to two thinking conditions: intuitive (general impressions) and analytical (calculations).

Materials. Each participant was presented with 2 sets of eighteen 2-digit numbers: (1) *18-simultaneous*: The numbers "69, 64, 68, 70, 75, 74, 46, 57, 41, 50, 55, 51, 69, 62, 65, 60, 50, 54" (average: 60) were presented simultaneously, in 3 rows of 6 numbers each, and remained on the screen for the entire evaluation interval (i.e., until the participant made the evaluation). (2) *18-sequential:* The numbers "54, 47, 50, 45, 35, 39, 31, 42, 26, 35, 40, 36, 54, 49, 53, 55, 60, 59" (average:45), was presented sequentially, in a random order, at a pace which was self- determined by each participant. When a participant felt ready, s/he pressed any key and the number was replaced by the following number.

Procedure. Participants were told that they would be presented with two sequences of 2-digit numbers, and requested to evaluate their averages. The term "evaluate" was selected since it does not direct participants to use a specific thinking mode. The manipulation of the thinking modes was based on Dehaene's observation of two distinct numerical processing routes. Participants in the analytical thinking condition were asked "to base their evaluation on numerical rules, and avoid reliance on general impressions". Participants in the intuitive thinking condition were asked "to form an impression of the magnitude of the numbers, and base their evaluation on that impression". They were also asked "to avoid the application of rules". After the initial instructions, each participant was administered with the two evaluation tasks, in a random order. After estimating the average value, participants were asked to describe how they reached their evaluation.

5 Results and Discussion

Participants' verbal reports (provided in their debriefing) confirmed that they followed the instructions to use rules, or form impressions, respectively. The evaluations of one participant that reported calculating the sum instead of the average value, were eliminated from the analysis.

We first examine RT, as an indication of compliance with the mind-set instructions. A 2 (thinking mode) x 2 (presentation format) repeated measures ANOVA for the time elapsed from the beginning of stimulus presentation until evaluation was made (Fig. 1) generated a main effect for thinking mode $F[1, 25] = 23.13$, $p < 0.0001$, $\eta^2 = 0.51$, and a main effect for presentation format $F[1, 25] = 7.08$, $p = 0.014$, $\eta^2 = 0.24$. Post- hoc tests found that the time interval required for the analytical evaluations was significantly longer than for the intuitive evaluations both under the *"18-simultaneous"* ($p = 0.003$) and *"18-sequential"*

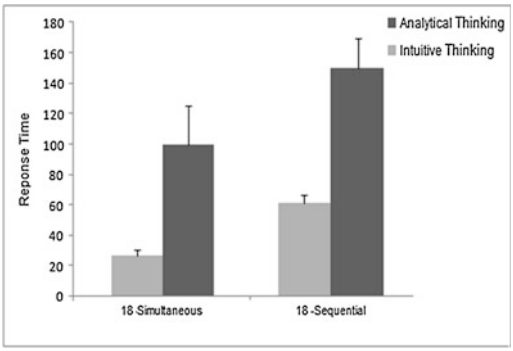


Fig. 1 Response times in experiment 1

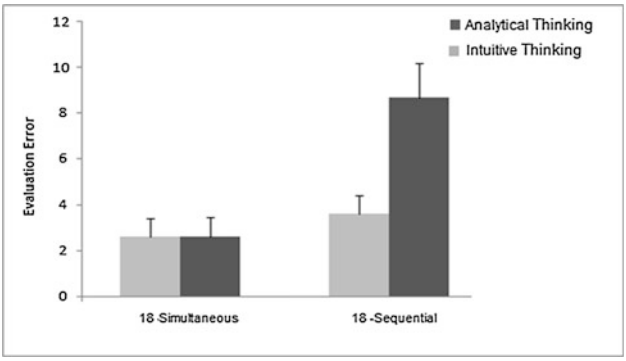


Fig. 2 Accuracy of evaluations in experiment 1

($p = 0.00038$) tasks. Thus, the longer RTs in the analytical than in the intuitive conditions indicate that the observers complied with the mind-set instructions.

We now turn to the critical measure of evaluation accuracy. The mean absolute deviations of the evaluations are presented in Fig. 2.

A 2 (thinking mode: analytical or intuitive) x 2 (presentation format: simultaneous or sequential) x 2 (task order: sequential first or simultaneous first) repeated measures ANOVA for the absolute deviations from the actual average produced a significant main effect of the thinking mode $F[1, 23] = 6.07$, $p = 0.02$, $\eta^2 = 0.21$, a significant main effect of the presentation format $F[1, 23] = 15.74$, $p = 0.0006$, $\eta^2 = 0.41$, and a significant interaction between the thinking mode and the presentation format $F[1, 23] = 7.11$, $p = 0.01$, $\eta^2 = 0.24$. Task order did not produce a significant effect, nor an interactions with other variables. Planned comparisons found that under the "*18-simultaneous*" task there was no significant difference between intuitive and analytical deviations $F[1, 23] = 0.03$, $p = 0.85$, but under the "*18-sequential*" task, the deviations of the intuitive evaluations from the actual average value were significantly smaller than the analytical deviations

F[1, 23] = 9.57, p = 0.005. Specifically, the sequential presentation led to poorer analytical evaluations F[1, 23] = 21.34, p = 0.0001, but did not have a significant effect on the intuitive evaluations F[1, 23] = 0.87, p = 0.36.

The results correspond our first and second assumptions. In line with our first assumption, under high information load (18 numbers in a sequential presentation), participants were much more accurate in their numerical average evaluation when given intuitive compared to analytic (rule-following) instructions, despite the fact that in the latter they employed mathematical rules and took more time to look at the numbers. When the task involved 18 numbers presented simultaneously, analytical evaluations were more accurate, but the difference was not significant. In support to our second hypotheses, a sequential presentation of the information (as opposed to a simultaneous presentation) disrupted analytical but not intuitive evaluations.

Although the results obtained in experiment 1 conformed to the pattern hypnotized, it also appears possible that this pattern reflects an alternative explanation of a difficulty effect. That is, the "18-simultaneous" and "18-sequential" conditions differed not only in the mode of presentation but also in the numbers used (as a different set of numbers was used for each of the two conditions). It might have been that both sets of numbers are not equally difficult to average. If they differ in difficulty, this is a methodological confound and might threat the validity of the conclusions. This possibility will be addressed in experiment 2.

Experiment 2 aimed at examining the effect of information load (engendered by the number of items) on the relative advantage of the two thinking modes. Information load was varied by varying the number of items (three versus eighteen) to be averaged and the average value of each sequence (45 or 60 in the high load and 25 or 30 in the low load condition).

In addition, in order to address the possible confound engendered by the presentation of two different sets of numbers in experiment 1, both sets of numbers were included in experiment 2, under the same presentation format. If the effect in experiment 1 reflects that both sets of numbers are not equally difficult to average, a similar effect should emerge also when the same presentation format is employed for both

6 Method

Participants. Forty undergraduate students from the Interdisciplinary Center (IDC) in Herzliya, Israel were randomly assigned to two thinking conditions: intuitive (general impressions) and analytical (calculations).

Materials. Each participant was presented with 4 evaluation tasks: 2 sets of eighteen 2-digit numbers (the same sequences of numbers that were used in experiment 1) and 2 sets of three 2-digit numbers: (1) *18-numbers 1*- The sequence "69, 64, 68, 70, 75, 74, 46, 57, 41, 50, 55, 51, 69, 62, 65, 60, 50, 54" (average: 60). (2) *18-numbers 2:* The sequence "54, 47, 50, 45, 35, 39, 31, 42, 26, 35, 40, 36, 54,

49, 53, 55, 60, 59" (average:45). (3) *3-numbers 1*- The sequence "28, 32, 15" (average: 25). (4) *3-numbers 2*- The sequence "12, 48, 30" (average: 30). The numbers of each sequences were presented sequentially in a random order, at a pace which was self- determined by each participant. When a participant felt ready, s/he pressed any key and the number was replaced by the following number.

Procedure. The order of the tasks was random. The instructions and the thinking manipulation were identical to those of Experiment 1.

7 Results and Discussion

The evaluations of three participants in the analytical condition and two participants in the intuitive condition were eliminated from the analysis, because some of their evaluations were not 2-digit numbers.

First, we compared the patterns of evaluation errors within the two eighteen numbers sequences and within the three-numbers sequences under each mode of thought in order to examine the possibility of an effect of task difficulty. Planned comparisons did not find any significant difference between the two eighteen-numbers sequences under the analytical condition $F(1,33) = 2.78$, $p = 0.14$ nor under the intuitive condition $F(1,33) = 0.007$, $p = 0.93$. Similarly, no significant difference was found between the two three-numbers sequences under the analytical condition $F(1,33) = 0.002$, $p = 0.97$ or under the intuitive condition $F(1,33) = 0.33$, $p = 0.57$.

We now examine the effects of thinking mode and task complexity. The mean absolute deviations of the evaluations are presented in Fig. 3.

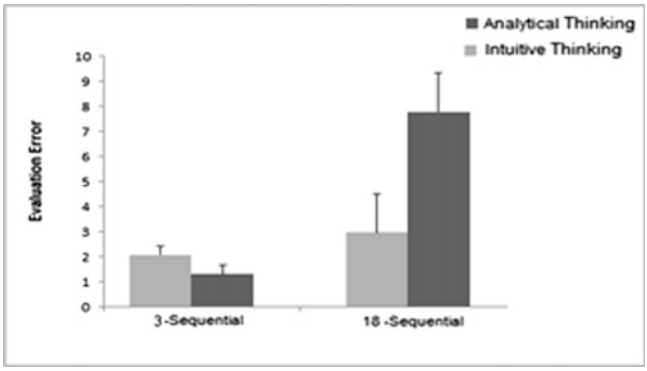


Fig. 3 Accuracy of evaluations in experiment 2

A 2 (thinking mode: analytical or intuitive) x 2 (task complexity: 18 numbers or 3 numbers) repeated measures ANOVA for the absolute deviations from the actual average produced a significant main effect of the complexity $F(1,33) = 10.63$, $p = 0.003$, $\eta^2 = 0.24$, and a significant interaction between the thinking mode and the complexity $F(1,33) = 6.12$, $p = 0.02$, $\eta^2 = 0.16$. Planned comparisons found that under the "*3-numbers*" tasks there was no significant difference between intuitive and analytical deviations $F(1,33) = 2.54$, $p = 0.12$, but under the "*18-numbers*" task, intuitive evaluations were more accurate than the analytical deviations $F(1,33) = 4.83$, $p = 0.04$. Specifically, the increased complexity led to poorer analytical evaluations $F(1,33) = 15.99$, $p = 0.0003$, but did not have a significant effect on the intuitive evaluations $F(1,33) = 0.32$, $p = 0.58$.

The obtained results thus provide additional support for our first assumption and conform to our third assumption. In addition, our analysis eliminates the possibility that the effect obtained in experiment 1 is due to differences in the sets of numbers. When the two sets of numbers were presented under an identical presentation format, No effect of different accuracy emerged. Hence, it is safe to assume that the effect obtained in experiment 1 is due to the presentation format rather than the due to specific set of numbers.

8 An Integrated Information Load Analysis of Experiments 1 and 2

Our results suggest that the accuracy of analytical evaluations is contingent on the information load that is induced by the complexity level of task and the information presentation format. The accumulated data from these two experiments allowed us to further examine whether there was a linear trend for the effect of information load on the accuracy of analytical or intuitive evaluations. According to our first hypothesis, we anticipated that higher levels of information load would disrupt the accuracy of analytic but not intuitive evaluations. To test our assumption, we looked into the data gathered in the two experiments and examined the relations between information load and errors of each of the thinking modes.

8.1 Data Analysis Method

Our data included three types of experimental conditions: (1) *"Eighteen numbers presented sequentially"* contained the data gathered in the "*18-sequential*" condition in experiment 1 and in the "*18-numbers-1*" and "*18-numbers-2*" conditions in experiment 2. (2) "Eighteen numbers presented simultaneously" contained the data gathered in the "*18-simultaneous*" condition in experiment 1. (3) *"Three numbers*

Table 1 Tasks administered in experiments 1 and 2

Number of items	Presentation format	Level of information load (mean and SD)
3	Simultaneous	2.6 (1.58)
3	Sequential	5.4 (3.13)
18	Simultaneous	6.8 (1.9)***
18	Sequential	8.2 (1.8)**

presented sequentially" contained the data gathered in the "*3-numbers-1*" and "*3-numbers-2*" conditions in experiment 2.

In order to assess the information load involved in each of these conditions, we asked an independent group of ten psychology students to perform four tasks of average evaluation: 3 numbers presented simultaneously, 3 numbers presented sequentially, 18 numbers presented simultaneously and 18 numbers presented sequentially. Each student performed all four tasks in a random order. The sequences of numbers to be evaluated were the same sequences that were presented in experiments 1 and 2 and were counterbalanced between task conditions. After participants completed all evaluations, they were presented again with the tasks and asked to rate the degree of information load induced by each evaluation task on a 9-point scale ranging from 1 = "not difficult at all" to 9-"very difficult" (Table 1).

Information Load refers to the average load as evaluated by 8 PhD and MA students

8.2 Data Analysis Results

First we examined the effect of task complexity and presentation format on the perceived levels of information load. A 2 (complexity: 3 versus 18 numbers) x 2 (presentation format: simultaneous versus sequential) repeated measures ANOVA for the estimations of perceived load produced a significant main effect of the complexity $F(1,9) = 38.02$, $p = 0.0002$, $\eta^2 = 0.81$, a significant main effect of presentation format $F(1,9) = 11.89$, $p = 0.007$, $\eta^2 = 0.57$, and no interaction between complexity and format. Hence, both the level of complexity and the presentation format affected the perceived levels of information load.

Now we examined the relationship between information load and the quality of analytic and intuitive evaluations. Figure 4 presents the accuracy of the evaluation as a function of thinking mode and information load.

A factorial regression analysis yielded a significant main effect of thinking mode $F(1,120) = 7.7$, $p = 0.006$, $\eta^2 = 0.06$, a significant main effect of information load $F(1,120) = 11.07$, $p = 0.001$, $\eta^2 = 0.08$ and a significant interaction between thinking mode and information load $F(1,120) = 10.92$, $p = 0.001$, $\eta^2 = 0.08$. Simple regression analysis of the evaluation error, with the level of information

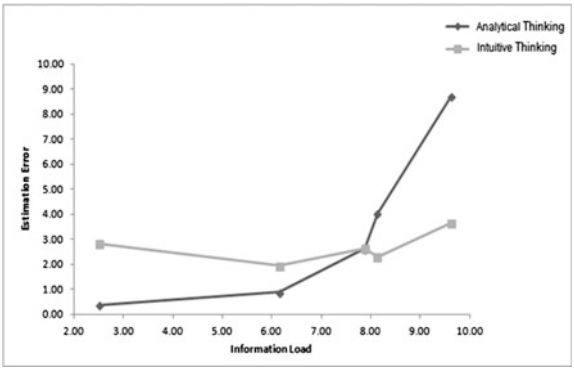


Fig. 4 Evaluations errors as a function of information load

load as an independent variable showed a significant effect of load on the accuracy of the analytical evaluation $F(1,58) = 17.26$, $p = 0.0001$ $\eta^2 = 0.23$, but no effect on the accuracy of intuitive evaluations $F(1,62) = 3.16$, $p = 0.08$, $\eta^2 = 0.05$.

9 General Discussion

Our findings show that contrary to previous theoretical claims that analytical thinking is more suitable than intuitive thinking for rule-governed computation, under certain conditions intuitive average evaluations can even outperform analytical evaluations. Together, the two experiments and the integrated analysis reported here set boundary conditions on the advantage of analytical thinking in numerical evaluations, and illustrate the impact of information load on the relative accuracy of intuitive vs. analytical averaging. Intuitive evaluations were more accurate than analytical evaluations under high information load (i.e., when the task involved many numbers and a sequential presentation), whereas no differences in accuracy were found under medium levels of information load. This pattern of results is compatible with past assertions that reliance on intuition often leads to better performance than analysis [13, 24, 32] and with recent findings of fast intuitive numerical value integration [26, 27, 29, 30, 32], and might illuminate why intuitive representations of the mental number line influence valuations across multiple decision contexts [1].

These findings support the theoretical contention that tasks that involve high information load are less compatible with analytical thinking [11, 16, 17] and extend previous empirical findings by demonstrating that the advantage of intuitive thinking in complex settings holds even when numerical judgment tasks are involved.

Interestingly, the detrimental effect of the sequential presentation of information on analytical evaluations runs exactly counter to the claim that the sequential presentation of information is compatible with analytical thinking, and simultaneous presentation is compatible with intuition [17, 29, 38]. This effect might stem

from the structured nature of analytical thinking [10] and its dependence on the completeness of information [16], and from the information load that is engendered by the sequential processing in an average estimation task.

References

1. Peters, E., Slovic, P., Västfjäll, D., Mertz, C.: Intuitive numbers guide decisions. Judgm. Decis. Mak. **3**, 619–6352008))
2. Reyna, V.F., Nelson, W.L., Han, P.K., Dieckmann, N.F.: How numeracy influences risk comprehension and medical decision making. Psychol. Bull. **135**(6), 943 (2009)
3. Roe, R.M., Busemeyer, J.R., Townsend, J.T.: Multialternative decision field theory: a dynamic connectionist model of decision making. Psychol. Rev. New York **108**(2), 370–392 (2001)
4. Hertwig, R., Erev, I.: The description-experience gap in risky choice. Trends Cogn. Sci. **13** (12), 517–523 (2009)
5. Dehaene, S.: Varieties of numerical abilities. Cognition **44**, 1–4 (1992)
6. Dehaene, S.: Symbols and quantities in parietal cortex: elements of a mathematical theory of number representation and manipulation. In: Haggard, P., Rossetti, Y. (eds.) Attention & Performance XXII. Sensori-Motor Foundations of Higher Cognition, pp. 527–574 (2007)
7. Dehaene, S., Molko, N., Cohen, L., Wilson, A.: Arithmetic and the brain. Curr. Opin. Neurobiol. **14**, 218–224 (2004)
8. Brainerd, C.J., Reyna, V.F., Ceci, S.J.: Developmental reversals in false memory: a review of data and theory. Psychol. Bull. **134**(3), 343 (2008)
9. Epstein, S.: Integration of the cognitive and psychodynamic unconscious. Am. Psychol. **49**, 709–724 (1994)
10. Evans, J.S.B.T.: Dual-processing accounts of reasoning judgment and social cognition. Annu. Rev. Psychol. **59**, 255–278 (2008)
11. Kahneman, D.: A perspective on judgment and choice: mapping bounded rationality. Am. Psychol. **58**, 697–720 (2003)
12. Kahneman, D.: Thinking, fast and slow. Farrar, Straus and Giroux, New York (2011)
13. Reyna, V.F., Brainerd, C.J.: Fuzzy-trace theory: an interim synthesis. Learn. Individ. Differ. **7** (1), 1–75 (1995)
14. Sloman, S.A.: The empirical case for two systems of reasoning. Psychol. Bull. **119**, 3–21 (1996)
15. Stanovich, K.E., West, R.F.: On the relative independence of thinking biases and cognitive ability. J. Pers. Soc. Psychol. **94**, 672–695 (2008)
16. Hogarth, R.M.: Deciding analytically or trusting your intuition: the advantages and disadvantages of analytic and intuitive thought. In: Betsch, T., Haberstroh, S. (eds.) The routines of decision making, pp. 67–82. Mahwah: Erlbaum (2005)
17. Hammond, K.R., Hamm, R.M., Grassia, J., Pearson, T.: Direct comparison of the relative efficiency on intuitive and analytical cognition. IEEE Trans. Syst. Man Cybernet. **17**, 753–770 (1987)
18. Dijksterhuis, A.P., Nordgren, L.F.: A theory of unconscious thought. Perspect. Psychol. Sci. **1**, 95–109 (2006)
19. Armstrong, J.S., Denniston, W.B., Gordon, M.M.: The use of the decomposition principle in making judgments. Organ. Behav. Human Perform **14**(2), 257–263 (1975)
20. MacGregor, D.G., Armstrong, J.S.: Judgmental decomposition: when does it work? Int. J. Forecast. **10**, 495–506 (1994)
21. MacGregor, D.G., Lichtenstein, S., Slovic, P.: Structuring knowledge retrieval: an analysis of decomposed quantitative judgments. Organ. Behav. Hum. Decis. Process. **42**, 303–323 (1988)

22. McMackin, J., Slovic, P.: When does explicit justification impair decision making? J. Appl. Cogn. Psychol. **14**, 527–541 (2000)
23. Rusou, Z., Zakay, D., Usher, M.: Pitting intuitive and analytical thinking against each other: the case of transitivity. Psychon. Bull. Rev. 1–7 (2013)
24. Reyna, V.F., Brainerd, C.J.: Numeracy, ratio bias, and denominator neglect in judgments of risk and probability. Learn. Individ. Differ. **18**(1), 89–107 (2008)
25. Reyna, V.F., Estrada, S.M., DeMarinis, J.A., Myers, R.M., Stanisz, J.M., Mills, B.A.: Neurobiological and memory models of risky decision making in adolescents versus young adults. J. Exp. Psychol. Learn. Mem. Cogn. **37**(5), 1125 (2011)
26. Ariely, D.: Seeing sets: representation by statistical properties. Psychol. Sci. **12**, 157–162 (2001)
27. Betsch, T., Kaufmann, M., Lindow, F., Plessner, H., Hoffmann, K.: Different principles of information integration in implicit and explicit attitude formation. Eur. J. Soc. Psychol. **36**(6), 887–905 (2006)
28. Betsch, T., Glöckner, A.: Intuition in judgment and decision making: extensive thinking without effort. Psychol. Inq. **21**, 439–462 (2010)
29. Glöckner, A., Betsch, T.: Multiple-reason decision making based on automatic processing. J. Exp. Psychol. Learn. Mem. Cogn. **34**(5), 1055 (2008)
30. Glöckner, A., Betsch, T.: Decisions beyond boundaries: when more information is processed faster, than less. Acta Psychol. **139**, 532–542 (2012)
31. Peterson, C.R., Beach, L.R.: Man as an intuitive statistician. Psychol. Bull. **68**(1), 29–46 (1967)
32. Tsetsos, K., Chater, N., Usher, M.: Salience driven value integration explains decision biases and preference reversal. Proc. Natl. Acad. Sci. **109**(24), 9659–9664 (2012)
33. Hoffmann, J.A., von Helversen, B., Rieskamp, J.: Deliberation's blindsight—How cognitive load can improve judgments. Psychol. Sci. **24**(6), 869–879 (2013)
34. Morewedge, C.K., Kahneman, D.: Associative processes in intuitive judgment. Trends Cogn. Sci. **14**(10), 435–440 (2010)
35. Reyna, V.F.: A theory of medical decision making and health: fuzzy trace theory. Med. Decis. Making (2008)
36. Zakay, D., Wooler, S.: Time pressure, training, and decision effectiveness. Ergonomics **27**, 273–284 (1984)
37. Inbar, Y., Cone, J., Gilovich, T.: People's intuitions about intuitive insight and intuitive choice. J. Pers. Soc. Psychol. **99**(2), 232–247 (2010)
38. Söllner, A., Bröder, A., Hilbig, B.E.: Deliberation versus automaticity in decision making: which presentation format features facilitate automatic decision making? Judgm. Decis. Making **8**(3), 278–298 (2013)
39. Russo, J.E.: The value of unit price information. J. Mark. Res. **14**, 193–201 (1977)

Part IV
Education Research and Applications

Engagement in Social Learning: Detecting Engagement in Online Communities of Practice

Enrica Pesare, Teresa Roselli and Veronica Rossano

Abstract The education in informal learning contexts is spreading over the world. In these contexts, from a pedagogical point of view, the most used approaches is the social learning and, in particular the communities of practice (CoP). From a technological point of view, the social network is the framework most used to allow users to interact and to share resources. Several aspects have been identified as key factors for the success of the community, the engagement is one of the most important. Thus, in order to guarantee a successful learning process in a CoP it is necessary to detect and monitor user's engagement in a continuous and unobtrusive way. The research proposes a model to detect and measure the engagement in online communities by means Social Learning Analytics from log files.

Keywords Social network analysis · Social learning analytics · Community of practice

1 Introduction

Nowadays, a growing number of fields requires continue education: chronic disease management and workplace learning are only two examples. Thus learning can no longer be restricted to formal education. In these contexts, the use of Social Media is rising in order to support online communities thanks to their ability to connect people, to share information and to promote an effective social learning process.

In the research field on online communities, several aspects have been identified as key factors for the success of the community as a whole and for each single

E. Pesare (✉) · T. Roselli · V. Rossano
Università degli Studi di Bari Aldo Moro, Via Orabona 4, 70125 Bari, Italy
e-mail: enrica.pesare@uniba.it

T. Roselli
e-mail: teresa.roselli@uniba.it

V. Rossano
e-mail: veronica.rossano@uniba.it

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component [1–4]. Since ever, the engagement is one of the basic factors for the success of the community, indeed it represents the focus of interest of the learning process research.

Now its significance is rising also in informal learning contexts. In social learning, in particular in Communities of Practice (CoP), the engagement is strictly related to users' participation and expertise in the domain. In this context, the ability to detect and monitor user's engagement in a continuous but unobtrusive way is important (1) to allow the community manager to provide the users with the appropriate support; (2) to detect critical patterns; (3) to propose automate interventions to each participant.

Engagement detection has been deeply studied in traditional learning contexts, with subjective or objective methods and approaches with different levels of invasiveness. In particular, objective methods based on measure collected on users actions and interactions, for example log files, have been successfully proposed in high constraints environments, such as ITS (Intelligent Tutoring Systems). Few researches, instead, tackle this issue in low constrained interactive systems, such as online communities.

With these premises, our research work proposes a model to detect user engagement in online communities from log file analysis. To monitor the engagement of the user using a user-centered perspective, the proposed approach combines quantitative analysis of activities in the community with qualitative analysis of relationship among community members by means of social learning analytics.

2 Engagement Definition

Engagement has been identified as a key aspect in Technology Enhanced Learning research in order to sustain interest and participation and to promote the willingness to collaborate and learn from others [5]. Despite the recognized importance in education [6–9], the engagement has been mostly studied in traditional learning contexts rather than in informal ones. Furthermore, it has been analysed from different perspectives (sociological, pedagogical, etc.). This is the reason why there is not a wide agreement on its definition [10].

In the learning perspective engagement is often seen as a multidimensional construct. A large body of research is based on the definition proposed by Fredricks et al. [11], where three components have been defined: Behavioral, Emotional and Cognitive. Other authors define the engagement in terms of motivation: usually the two terms are used interchangeably while some authors take them into account as dependent constructs [12]. Anyway, the definition of engagement is strictly related to the particular context in which it is being used. In the specific context of social learning, and in particular in Communities of Practice, engagement could be defined in terms of users' participation and expertise in the domain [13, 14]. This kind of community is based on a core-periphery social structure where new users (peripheral members) interact with the experts (core members) allowing the

community to grow. The new members gradually acquire knowledge and skills thanks to the interaction with expert members. Usually, the experts are the members more involved in the community and in conversations; they are responsible both for the definition of new practices and the spread of knowledge among new members [15]. The CoP social structure is dynamic: user's engagement can increase or decrease over time. It is useful in this view, to define some engagement patterns or trajectories. *Peripheral trajectories* are those outlined by the users who show a limited participation in the community. The *inbound trajectories* are those outlined by the users who improve their participation over time. When the users become less involved in the community and gradually leave the *outbound trajectories* are defined, and the *boundary trajectories* are the users who are the bridge between different communities [16].

According to Wenger [17] the engagement of each single member, no matter how deep it is, represents the key to transform a network into a community. Social media tools and social network, indeed, provide the structure to optimize the connectivity among people and the access to information flows, but the community requires engagement in order to push the members to learn together, to help each other and to develop shared resources [17]. In CoP this is defined as mutual engagement since it refers to engagement with both other members and artifacts produced together [18]. For this reason, the engagement in CoP should be measured both in term of social participation and interaction with resources.

3 Detecting Engagement

Student engagement has been deeply studied according to different perspectives (psychological, sociological, pedagogical) using different instruments: scales and measures of engagement [19, 20], student self-report, experience sampling, teacher ratings of students, interviews, observation [21].

From a computer science perspective, the detection of engagement often falls in the research field of user affective state detection where several subjective or objective methods have been proposed [22, 23].

Subjective methods rely on self-report questionnaires or interviews. Questionnaires are not expensive, easy to be administered and analyzed but can suffer from ambiguities (in particular when abstract concepts like engagement are tackled). Interviews may be more accurate, but the results are more difficult to be administered and interpreted. Furthermore, one of the main problems of this kind of methods is that they are often post-activity measures (the reliability is based on the memory of the experience), or when proposed during the activity they can interrupt the user experience. In both cases, they do not allow changes in engagement to be measured [23].

Objective methods often rely on psychophysiological responses such as facial responses, electrodermal activity, cardiac activity, EEG [24], or eye tracking and body movements. Although these methods might allow real-time measurements, they are also highly invasive and can interfere with the user experience.

Furthermore, they are expensive and not applicable to large scale detections because of sensors are needed. Others objective methods are based on metrics that collect user's actions (such as keyboard and mouse movements) and interactions (such as log files in LMS): the main benefit relies on the possibility to analyze user behavior during the activity without interfering. Even if the debate on the reliability of metrics based on user actions to assess abstract concepts is open, the engagement influence on behavior is undeniable: the challenge is to select the relevant data to be converted into metrics in order to extract some valuable (i.e. interesting, interpretable and useful) information [23].

The approaches used in the wide corpus of researches on engagement in traditional learning contexts are very different. Some approaches propose the disengagement detection from analysis of logged events and their attributes [25], other approaches take into account sequence of events instead of isolated actions [26]. However the sequence mining of learner's actions is often adopted in high-constraint environments, like ITS, thanks to their limited range of actions, whereas they provide poor results in low-constrained interactive systems where the user's interaction is freer.

This is the reason why informal learning contexts require other approaches. Social Network Analysis (SNA), for example, aims at identifying patterns of social relations focusing on relationships among entities (actors and resources) in a social network. This approach has been usually adopted in Computer-Supported Collaborative Learning (CSCL) contexts to investigate who is involved in the collaborative learning task and to classify the participants in active and peripherally [27].

SNA has been also used to analyze participation and expertise in CoP. Nistor [14, 28] proposes the measurement of expert status using the betweenness centrality metric and the measurement of user participation using the number of interventions.

However, handling the amount of interactions and forgetting about quality may provide poor outcomes. This is why SNA is often proposed in association with other content analysis methods [27, 29] or qualitative evaluation [30]. Even in traditional learning contexts, the integrated approaches have provided deeper insights into the community [31–33] proving, as an example, correlation among SNA metrics and self-reported sense of community [34]. In the latest years, the Social Learning Analytics (SLA) research field [35] has adopted SNA in conjunction with other analysis techniques, not only to identify the network structure and ties but also to provide insights into acquired skills and developed contents in the network [36, 37]. These approaches are not new even in communities of practice, in [38] they are used to make visible the pattern of activities and the evolution of the community over time. The main drawback of this research is the manager-centered vision of the community. Indeed, the SLA are useful if addressed also to individual learners in order to support the learning process in the community, but no further works have been found on this topic.

Table 1 Interactions classification

	Passive	Active
Interactions with resources	Reading resources (Files, Links, Wikis, Scorm,…)	Producing, editing organizing, sharing resources (Files, Links, Wikis, Scorm,…)
		Using learning activities (Quizzes, Pools, …)
Human interactions	Reading conversations	Writing posts and comments
	Receiving comments	Taking part in social activities using Chats, Forums, …

4 A Model to Detect Engagement in Online Communities: A First Proposal

Starting from the literature review, the research aims at proposing a model to detect and measure the engagement in online communities. The engagement, indeed, is one of the most changing dimensions in the learning process. Thus in order to make the learning process effective, it is necessary to measure it continuously without interfering with the learning activities. Thus, the detection of engagement from log file analysis seems to be the best option among the different proposed methods. The challenge of this research is to define a model that, starting from the usual monitoring activities in an e-learning platform, allows measuring the student level of engagement during the learning process. Thus, the first step is to define the engagement dimensions to take into account. For this reasons our analysis firstly pointed out the features of the CoPs as proposed in the literature review: in particular, we focused the attention on the social structure of the community as described by Wenger [13].

Since the engagement is strictly related to the activities performed by the members of the community, our approach takes into account the different dimensions of interactions in the community. We distinguish different levels of engagement thus the interactions can be passive, such as downloading and reading resources, or active, such as producing, editing, organizing, sharing new contents [39]. Furthermore, the interactions are classified according to the target: interactions with tools and resources shared in the community or interactions with other members (i.e. conversations and other types of social life in the community). Both of them are required in order to promote successful social learning [18].

Those measures (as reported in Table 1) are collected at predefined time intervals, in order to make them comparable and to allow the engagement to be assessed over time.

5 Conclusion and Future Work

The proposed model is still under development. The first goal will be the integration of the defined metrics with SLA, then, the model will be validated.

To reach the first goal some Social Network Analytics [34] are under investigation. In particular, we are interested in the analysis of user participation and expertise in the domain using the centrality measures [14, 28]. Moreover we are also interested in integrating Discourse Analytics and Content Analytics [27, 29] to allow discovery and measurement of user's skills and expertise.

To validate the model, a pilot study involving two classes of undergraduate student from University of Bari Aldo Moro is being planned. Their courses are designed according to the CoP model, using a customized version of Moodle (https://moodle.org/) with the Socialwall course format (https://moodle.org/plugins/browse.php?list=set&id=74) and the standard Wiki as knowledge management tool. The defined metrics are collected and presented in an updated version of the dashboards presented in [40]. The early results seem promising but deeper investigations are still needed to validate the model and to define new metrics.

References

1. Preece, J.: Sociability and usability in online communities: determining and measuring success. Behav. Inf. Technol. **20**, 347–356 (2001)
2. Koh, J., Kim, Y.-G., Butler, B., Bock, G.-W.: Encouraging participation in virtual communities. Commun. ACM **50**, 68–73 (2007)
3. López, C., Brusilovsky, P.: Towards adaptive recruitment and engagement mechanisms in social systems. Lect. Notes Comput. Sci. (including Subser. Lect. Notes Artif. Intell. Lect. Notes Bioinformatics). **7138**, 382–396 (2012)
4. Iriberri, A., Leroy, G.: A life-cycle perspective on online community success. ACM Comput. Surv. **41**, 1–29 (2009)
5. Spector, J.M.: Conceptualizing the emerging field of smart learning environments. Smart Learn. Environ. **1**, 2 (2014)
6. Dabbagh, N., Kitsantas, A.: Personal Learning Environments, social media, and self-regulated learning: a natural formula for connecting formal and informal learning. Internet High. Educ. **15**, 3–8 (2012)
7. Boud, D., Middleton, H.: Learning from others at work: communities of practice and informal learning. J. Work. Learn. **15**, 194–202 (2003)
8. Billett, S.: Learning through work: workplace affordances and individual engagement. J. Work. Learn. **13**, 209–214 (2001)
9. Carini, R.M., Kuh, G.D., Klein, S.P.: Student engagement and student learning: testing the linkages. Res. High. Educ. **47**, 1–32 (2006)
10. Eccles, J., Wang, M.-T.: Part I Commentary: So What Is Student Engagement Anyway? Handbook of Research on Student Engagement, pp. 133–145. Springer (2012)
11. Fredricks, J., Blumenfeld, P.C., Paris, A.H.: School engagement: potential of the concept, state of the evidence. Rev. Educ. Res. **74**, 59–109 (2004)
12. Reschly, A.L., Christenson, S.L.: Jingle, Jangle, and Conceptual Haziness: Evolution and Future Directions of the Engagement Construct. Handbook of Research on Student Engagement, pp. 3–19 (2012)
13. Wenger, E.: Communities of Practice and Social Learning Systems: The Career of a Concept. A Social Systems View on Learning: Communities of Practice as Social Learning Systems, pp. 1–16 (1998)

14. Nistor, N., Baltes, B., Dascalu, M., Mihaila, D., Smeaton, G., Trausan-Matu, S.: Participation in virtual academic communities of practice under the influence of technology acceptance and community factors. A learning analytics application. Comput. Hum. Behav. **34**, 339–344 (2013)
15. Gray, B.: Informal learning in an online community of practice. Distance Educ. **19**, 20–35 (2004)
16. Wenger, E.: Conceptual tools for CoPs as social learning systems: boundaries, identity, trajectories and participation. Soc. Learn. Syst. Commun. Pract. 125–143 (2010)
17. Wenger, E., Trayner, B., De Laat, M.: Promoting and assessing value creation in communities and networks: a conceptual framework. Centrum **18**, 1–60 (2011)
18. Wenger, E.: Communities of practice and social learning systems: the career of a concept. Soc. Learn. Syst. Commun. Pract. 179–198 (2010)
19. Martin, A.J.: Examining a multidimensional model of student motivation and engagement using a construct validation approach. Br. J. Educ. Psychol. **77**, 413–440 (2007)
20. Kuh, G.D.: The National Survey of Student Engagement: Conceptual and Empirical Foundations. New Dir. institutional Res. 141, (2009)
21. Fredricks, J.A., McColskey, W.: The Measurement of Student Engagement: A Comparative Analysis of Various Methods and Student Self-report Instruments. Handbook of Research on Student Engagement, pp. 763–782 (2012)
22. Santos, O.C., Rodriguez-Ascaso, A., Boticario, J.G., Salmeron-Majadas, S., Quirós, P., Cabestrero, R.: Challenges for inclusive affective detection in educational scenarios. Lecture Notes in Computer Science (including subseries Lecture Notes in Artificial Intelligence and Lecture Notes in Bioinformatics), pp. 566–575 (2013)
23. Bouvier, P., Sehaba, K., Lavoué, É.: A Trace-Based Approach to Identifying Users' Engagement and Qualifying Their Engaged-Behaviours in Interactive Systems: Application to a Social Game (2014)
24. Kivikangas, J.M., Chanel, G., Cowley, B., Ekman, I., Salminen, M., Järvelä, S., Ravaja, N.: A review of the use of psychophysiological methods in game research. J. Gaming Virtual Worlds **3**, 181–199 (2011)
25. Cocea, M., Weibelzahl, S.: Log File Analysis for Disengagement Detection in e-Learning Environments (2009)
26. Beal, C.R., Qu, L., Lee, H.: Classifying learner engagement through integration of multiple data sources. Proc. Natl. Conf. Artif. Intell. **21**, 151 (2006)
27. Laat, M., Lally, V., Lipponen, L., Simons, R.-J.: Investigating patterns of interaction in networked learning and computer-supported collaborative learning: a role for social network analysis. Int. J. Comput. Collab. Learn. **2**, 87–103 (2007)
28. Nistor, N., Fischer, F.: Communities of practice in academia: testing a quantitative model. Learn. Cult. Soc. Interact. **1**, 114–126 (2012)
29. Jimoyiannis, A., Angelaina, S.: Towards an analysis framework for investigating students' engagement and learning in educational blogs. J. Comput. Assist. Learn. **28**, 222–234 (2012)
30. Martínez, A., Dimitriadis, Y., Rubia, B., Gómez, E., De la Fuente, P.: Combining qualitative evaluation and social network analysis for the study of classroom social interactions. Comput. Educ. **41**, 353–368 (2003)
31. Macfadyen, L.P., Dawson, S.: Mining LMS data to develop an "early warning system" for educators: a proof of concept. Comput. Educ. **54**, 588–599 (2010)
32. Dawson, S.: "Seeing" the learning community: an exploration of the development of a resource for monitoring online student networking. Br. J. Educ. Technol. **41**, 736–752 (2010)
33. De Laat, M.F., Lally, V., Lipponen, L., Simons, P.R.J.: Analysing student engagement with learning and tutoring activities in networked learning communities: a multi-method approach. Int. J. Web Based Commun. (2006)
34. Dawson, S.: A study of the relationship between student social networks and sense of community. Educ. Technol. Soc. **11**, 224–238 (2008)
35. Buckingham Shum, S., Ferguson, R.: Social learning analytics. Soc. Learn. Anal. **15**, 3–26 (2012)

36. Schreurs, B., Teplovs, C., Ferguson, R.: Visualizing social learning ties by type and topic: rationale and concept demonstrator. Learn. Anal. 33–37 (2013)
37. Schreurs, B., De Laat, M.: Network awareness tool—learning analytics in the workplace: detecting and analyzing informal workplace learning. Learn. Anal. Knowl. 59–64 (2012)
38. Cambridge, D., Perez-Lopez, K.: First steps towards a social learning analytics for online communities of practice for educators. In: Proceedings of the 2nd International Conference on Learning Analytics and Knowledge, pp. 69–72 (2012)
39. Preece, J., Shneiderman, B.: The reader-to-leader framework: motivating technology-mediated social participation. AIS Trans. Human-Comput. Interact. **1**, 13–32 (2009)
40. Pesare, E., Roselli, T., Rossano, V., Di Bitonto, P.: Digitally enhanced assessment in virtual learning environments. J. Vis. Lang. Comput. **31**, 252–259 (2015)

Incorporating Human Factors in Course Design: Utility of Wearable Technologies

Mohamed Ismail, Hamid Parsaei and Konstantinos Kakosimos

Abstract The purpose of this paper is to describe efforts taken by Texas A&M University at Qatar to bridge the gap between traditional modes of instruction and a new tech-savvy student populace. The undertaking proved to be challenging as it required addressing the buildup of a technology infrastructure, development of training programs, and establishment of motivational strategies to encourage experimentation with innovative teaching ideas. One promising idea that resulted from the aforementioned efforts showed that the approach of incorporating elements of technologies that are pervasive among students in course design has the potential to promote acceptance and enable effectiveness. A pilot study that is discussed in this paper utilized a wearable technology with an optical head mounted display to develop multimedia instructions for chemical engineering students. Student surveys revealed mixed reactions to different parts of the study but the overall enthusiasm about the approach remained positive.

Keywords Wearable technologies · Augmented reality · Human factors · Video instruction · Engineering education

1 Introduction

The precipitous increase in the popularity of modern technologies among students is increasingly challenging the status quo of the educational system. Higher education institutions need to evolve and reinvent many of the practices to appeal to their student populace. Pairing teaching and learning strategies with appropriate

M. Ismail (✉) · H. Parsaei (✉) · K. Kakosimos (✉)
Texas A&M University at Qatar, Education City, Doha, Qatar
e-mail: Mohamed.Ismail@qatar.tamu.edu

H. Parsaei
e-mail: Hamid.Parsaei@qatar.tamu.edu

K. Kakosimos
e-mail: K.Kakosimos@qatar.tamu.edu

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device and technology trends can greatly enhance the motivation to learn [1–3]. Ergonomics and human factors can play a critical role in analyzing the abilities and behaviors of student users and employing the gained knowledge in designing tools, products, and systems that are safer, acceptable, and more effective.

Generational research has already identified many of the characteristics of new student learners [4]. Although much of the work done focused on specific geographies, it is safe to say that many of the attributes are applicable to the Middle Eastern student population. This observation is particularly true in relation to technology linked traits: Students are tech-savvy, accustomed to using social media sites and tools, dependent on search engines for information, comfortable exploring new technologies, and enjoy gaming more than any other generation [5]. Additionally, new student generations are good at multi-tasking, value collaboration, and often mix work and leisure times [5, 6]. Optimizing the outcomes of technology implementations require accounting for user characteristics.

Wearable technologies equipped with augmented reality capabilities offer a lot of promise for education and training especially for the applied science disciplines. Such technologies have features that greatly align with the expectations of young student. This is by no chance coincidental as many of the people involved in the design and development of new emerging technologies belong to the younger generation.

The purpose of this paper is to explore the development of visual support tools to enhance the instructional experience of chemical engineering students actively involved in laboratory experimentation activities while mitigating the challenges of laboratory work. Laboratories offer rich environments for instructional innovation and the impact of technology on learning could be profound. The approach discussed focuses on the utilization of wearable technologies to develop alternatives to paper-based instruction including video and Augmented Reality (AR) enhanced instruction.

2 Motivation

Integrating technology in engineering education has been a primary objective at Texas A&M University at Qatar. Several steps were taken to enable the accomplishment of this objective including the build-up of educational technology infrastructure, establishment of professional development programs, and introduction of motivational strategies to encourage experimentation with innovative ideas that improve teaching and learning [7]. This study is the result of a technology competition that was sponsored in support of the motivational efforts carried out by the university. Although the study is specific to chemical engineering, the ideas presented can be easily extended to other engineering disciplines.

Integral to engineering instruction is educational laboratories which provide students with the hands-on experience necessary to supplement and clarify the scientific theory discussed in lectures. The practical nature of laboratory settings offers a rich ground for developing innovative solutions to enhance the instructional experience of students. The main drawback in such settings is the added risk involved. Technology has the potential to address both aspects.

Information about Standard Operating Procedures and safety policies as well as step-by-step instructions for performing the experiments are usually shared with students at different points during the semester. Information distribution is mainly done via paper documents with text and graphics content. During laboratory time, students are expected to bring the paper instructions and start conducting the experiment while continuously referencing the materials for procedures and directions. This protocol for disseminating information and operating in laboratory environments represents the standard followed by the majority of academic institutions. Neither the content format nor the delivery methods appeal to young students who have preferences that are different than past generations. The lack of appeal can lead to lack of motivation. Updating existing protocols to take student expectations into consideration is therefore important to counteract such negative effects. Incorporating technology-enhanced methods that communicate information through visuals rather than graphics and text, support mobile internet features, and provide game-style elements can improve the instructional experience while significantly increasing student interest and motivation [5, 8, 9].

3 Methodology

The approach pursued to achieve the objectives the study set out to accomplish focused on the utilization of wearable technologies with AR capabilities. The choice of AR is due to the ability of the technology to supplement real laboratory views with computer-generated messages that make the augmented experience richer, safer, and more informative. The wearable technology device of choice was the Google Glass. The glass includes features with strong appeal to the younger generations and supports capabilities for intelligent AR operation. Vuforia and Unity were the development frameworks utilized for building the AR functionality along with other application features. A major challenge of the proposed setup was the complexity of the development effort associated with building a functional AR prototype for the trials.

Execution of the proposed approach focused on the Thermo-Gravimetric Analysis procedure. Despite the limitation to one procedure, there are no technical reasons as to why the approach could not be duplicated with other experimental procedures practiced in chemical engineering laboratories.

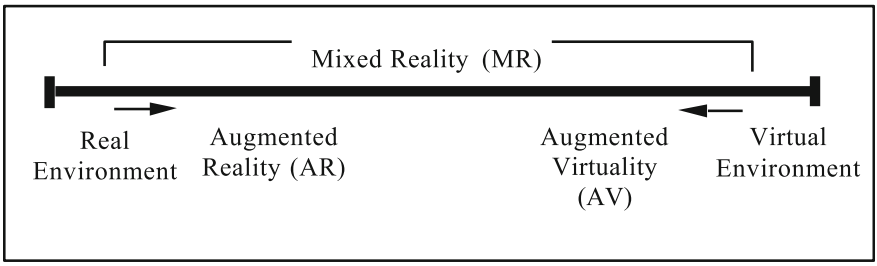


Fig. 1 Reality-virtuality (RV) continuum [11]

4 Overview of Augmented Reality

Augmented reality is a promising innovative technology that blends and overlays live direct or indirect real-world physical environments with computer-generated virtual objects in real time [10]. According to the concept of reality-virtuality continuum shown in Fig. 1, AR represents states on the left of the Mixed-Reality region of the continuum that are closer to the pure reality limit [11, 12]. In essence, the technology enhances one's perception of reality through computer generated sensory cues such as sound, video, graphics, or haptic feedback to create a new mixed-reality environment that is richer and more informative than the primary natural environment [13].

Until recently, use of the AR technology was restricted to experimental settings in high-end research laboratories. Recent technological leaps, however, produced mobile AR systems that are extremely powerful and cost effective and this opened the door for the development of new interactive devices with remarkable capabilities. Coupling powerful hardware platforms with new development tools that are considerably less complex for the average developer triggered the renewed interest in the technology.

The potential of AR in higher education is just beginning to emerge [14–16]. Applications of the technology in educational contexts are being extensively investigated by many researchers [17–19]. The impact of AR on teaching and learning is also being examined [20, 21]. Results suggest that AR applications are effective at improving conceptualization and understanding while being noble motivational tools for students. One potential barrier to the widespread use of the technology in education is the time and technical skills required to develop AR tools and content [22].

5 Video-Enhanced Instruction

Initial efforts to enhance the instructional experience of students involved replacing standard paper documents and instructions with training and instructional videos recorded by the instructor or one of the laboratory managers using the Google

Glass. Training videos aimed to demonstrate different aspects of lab operations while the instructional videos aimed to provide step by step instructions for executing SOPs and safety procedures. The recording process was quite simple and only required wearing the glass while performing a task in the actual laboratory environment. The advantage of the videos recorded using Glass is the first-person views they provided. Wearing Glass to watch the videos provided students with a view of the activity being demonstrated from the point of view of the preparer. References to videos in the following sections imply wearing Glass to watch the recorded material.

For the purpose of this study, the impact of the proposed approach on the instructional experience of students was measured in terms of two factors: learning and training, and execution and support. In order to evaluate the effectiveness of the proposed approach on instructional experience as a whole, the impact on each of the individual factors had to be considered.

The learning and training factor assess how the instructional experience is impacted when replacing standard paper documents with training videos while being in lab settings. A student going through SOP training wears the glass inside the actual laboratory and activates the training video while facing relevant equipment. Seeing the actual equipment provides a direct feel of the procedure being demonstrated which could enhance student understanding.

The execution and support factor evaluates how the instructional experience is affected when typical paper instructions are replaced by video instructions to guide the execution of an SOP. A student needing to execute an SOP wears Glass and visually follows the video instructions specific to the SOP.

5.1 Impact Assessment

Prior to the beginning of the study, engineering students were invited to participate in an AR experiment. Twenty students volunteered to participate but only thirteen completed all stages of the trials. Furthermore, 25 % of the students reported no prior exposure to chemical engineering lab activities. The study structure involved splitting participants into two groups designated as A and B. The two groups had to execute a single SOP twice: Once utilizing Glass and once employing traditional methods without Glass. An unidentified SOP with ten distinct steps was selected for this purpose. The two trials were denoted by Glass-ON and Glass-OFF respectively. Participants had to perform the two trials individually with members of group A having to execute the SOP following a Glass-OFF/Glass-ON sequence while members of group B having to follow the reverse sequence of Glass-ON-Glass-OFF. The two trials performed by a single student had to be separated by a minimum of two days. Before the beginning of a trial, the student is provided with training material relevant to the trial for brief review. The training material consisted of either paper documents for the Glass-OFF trials or training videos for the

Glass-ON sessions. Once a trial starts, the student is provided with the proper instructional content, either paper or video, necessary for completing the SOP.

Prior to the start of trials, participating students attended a preparatory session which provided background information about the study as well as details about the envisioned setup. To further motivate them, the session employed video material about Google Glass, AR, and their potential applications in engineering education. At the conclusion of the orientation session, students were instructed to select two fifteen minute slots that are at least two days apart. In addition, students were surveyed to examine their initial expectations about video instructions and Google Glass.

Student surveys were used throughout the trials to assess the impact of the proposed approach on the instructional experience of students. Specific sections of the surveys focused on how students perceived training videos shared with them before trials on learning and training. Other sections examined student opinions about Glass and the impact of instructional videos on the execution and support of SOPs.

5.2 Learning and Training

A Likert scale survey consisting of three questions specific to training videos was administered to students after the orientation session in order to establish a baseline for comparing the post-training survey results. At the end of each trial, students had to retake the survey to measure changes in their sentiments as a result of the video training. The survey results are provided in Table 1. The results are filtered to reflect the "Agree" and "Strongly Agree" values only.

Responses to the first question in the pre-training survey indicate that 100 % of the students prefer training videos over the standard paper documentation. The positive sentiment continued to hold at 100 % after completing the video training. This result was expected as new generations of students are known to prefer visual communications over text and graphics. Analysis of the pre-training student responses to the second and third questions provides further evidence that students favor training videos over traditional paper documents. Whereas only 30 % of the students believed that paper documents are useful and easy to follow, 100 % of the participants believed the same about training videos. Post training, the percentages for the second and third questions remained strongly in favor of training videos

Table 1 Pre and post trials survey results for learning and training

Question	Pre-training (%)	Post-training (%)
Q1. I prefer recorded material over written documents for this type of training	100	100
Q2. Training videos are useful and easy to follow	100	85
Q3. Paper documents are useful and easy to follow	30	60

despite changes in the percentages. Responses to the second question revealed positive sentiments in 85 % of the cases while the results reported for the third question showed agreement by 60 % of the students surveyed. The drop in the post training percentage for the second question and the corresponding rise in the post training percentage for the third questions are both attributed to negative Glass-ON experiences resulting from defects in the prepared videos. Overall, results came in line with expectations.

5.3 Execution and Support

Using Glass as visual aid for the execution and support of SOPs and safety instructions proved unsatisfactory. Analysis of data gathered from student surveys administered after each trial did not reveal any significant variation between the two trial sequences. In essence, the students did not feel that the use of Glass for execution and support was making a difference. This is contrary to the initial expectations enforced by the pre-trials opinion of 80 % of the students who expected the Glass-ON experience for executing an SOP to be far more positive than the traditional paper-based process. The perceived ineffectiveness of Glass can be attributed to a combination of factors including application instabilities, usability issues, and the lack of skills necessary for proper and smooth operation of Glass.

Whereas the use of Glass for mainstream learning and training would be constrained to few sessions, a more general use for execution and support would be routine. As such, usability aspects become more relevant to the assessment efforts. Questions about the usability of Glass were incorporated in the pre and post trials surveys. The questions targeted to measure changes in student expectations in relation to the advantages and disadvantages of Glass. The major advantage anticipated by 90 % of the students surveyed was the hands-free operation. This is in contrast to the 10 % who predicted the same about the visual support capabilities. In terms of disadvantages, 30 % of participants expected the small size of the head display to be problematic while one student expressed concern about the device's fit and the need for continuous readjustment. Analysis of the post trials survey data revealed significant changes in the results pertaining to the disadvantages of the device. The need to continuously readjust the fit became the biggest disadvantage as expressed by 70 % of the students. The percentage of students who thought the size of the head display is problematic slightly dropped to 25 %. Another inconvenience that was reported in the post trials surveys by 15 % of the students is the need to frequently touch Glass in order to prevent it from going into standby mode.

The impact of Glass on execution and support has so far been investigated in terms of subjective measures. In order to quantify the impact, data points connected to the number of successful SOP steps completed and time to complete the entire SOP were collected and analyzed. While the majority of students successfully

completed all the steps of the SOP in both of their trials, two students suffered the inconvenience of entering Glass' standby mode and eventually missed one step as they attempted to reactivate Glass and resume the SOP. The average time required to complete the SOP favored the traditional paper approach by 2 min. Students had difficulty in executing the SOP while navigating Glass due to the lack of training on device controls. The delay issue, however, could easily be resolved through proper training and sufficient exposure to Glass.

Contrary to initial expectations, the use of Glass did not provide any clear advantage over traditional methods in terms of the execution and support function. A deep dive into the reasons behind the negative assessments point to training and implementation issues rather than methodology or technology problems. This is comforting as both issues can be mitigated.

6 AR-Enhanced Instruction

Thus far, the discussion focused on enhancing the instructional experience through the use of training videos recorded via the Google Glass. The videos, however, lacked any interactivity with the actual laboratory environment. A more engaging approach that can significantly enrich student experiences while mitigating some of the risks involves employing AR technology.

The direction pursued encompassed tagging chemicals, substances, and instrumentation with QR codes, and utilizing AR technology to blend the QR feed information and procedural instructions with the actual laboratory environment. An individual wearing the glass starts by selecting a particular procedure to execute. Procedural summary appears as a list in an inset that overlays the laboratory view. The wearer then receives instruction to take specific actions. Every time an action is completed, instructions for the next action are provided. Completion in this case is defined in terms of detecting the right QR code associated with the proper substance or the right instrumentation. At every step in the process, real time views of the actual lab environment are overlaid by relevant information. Figure 2 shows still captures from Glass views recorded during one of the demonstrations for the tool where the task was to select the proper sample for a thermal analysis procedure.

As shown in the figure, the activity started with a procedural summary identifying the need for sample S05. As the user attempted to locate the sample, the QR code for a cabinet that the user visited was scanned and the nature of substances inside it were identified. The user then went on to examine the different samples inside the cabinet where he was receiving instant feedback about the correctness of the sample picked. The wearer is then instructed to go to the next step of the procedure which is checking the status of the cooler. Figure 3 provides captures from the same demonstration for the cooler and cylinder checks of the procedure.

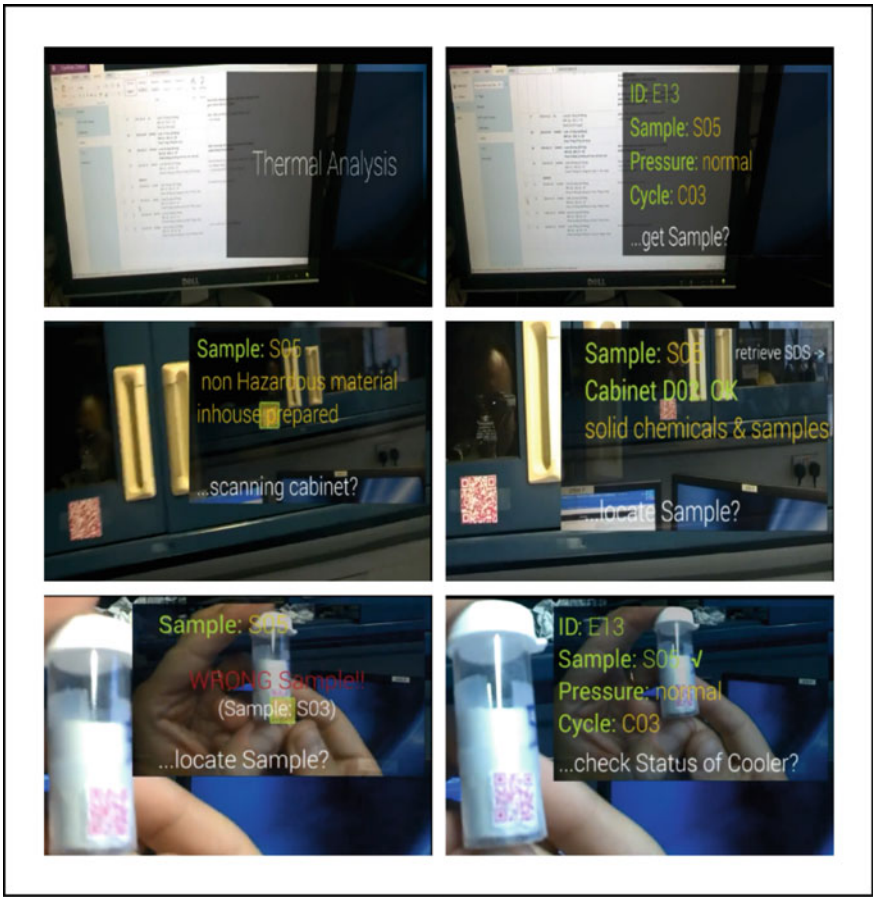


Fig. 2 Illustration of the use of AR for sample selection

In the first capture, the wearer received the task completion check. The wearer was then instructed to investigate the various cylinders for proper pressure. As the user began to examine the cylinders, information about their contents and proper settings was displayed. The feedback provided was then utilized by the wearer to properly set the gauges.

Due to time limitations of the competition, no formal assessment was conducted to judge this effort. Although the results presented are only intended for proof of concept, the general approach has the potential to significantly improve the instructional experience for students. Furthermore, using AR to guide actions has the potential to reduce human errors associated with experimental procedures and can lead to safer practices.

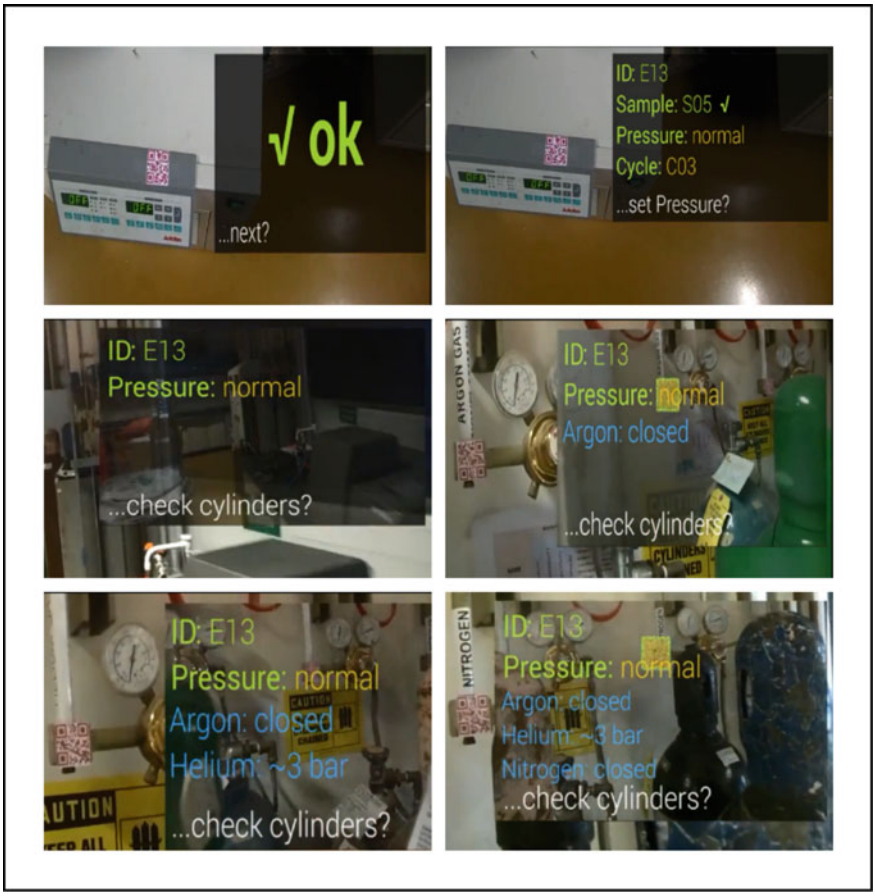


Fig. 3 Illustration of the use of AR for guiding lab actions

7 Conclusion

Lab activities are an integral part of engineering education. Enhancing the educational experience associated with laboratory work to account for changing student expectations necessitates investigating alternative approaches to the traditional methods of instruction. The rising popularity of wearable devices among young students provides educators with new possibilities to improve upon the traditional content and to offer a whole new level of interactive learning experience. This paper presented information about a pilot study that explored alternative modes of laboratory instruction. The main purpose was to provide students with an enhanced instructional experience to keep them engaged and motivated. The study started by examining the impact of replacing traditional paper-based documents with videos instructions. Results did not align with initial expectation due to implementation

and training issues. Additional extensions to the study involved investigating AR-enhanced instruction. The potential of AR to produce real-world, safer and more engaging experience is clear, however, more development work is required.

References

1. Jonassen, D.H., Carr, C., Yueh, H.P.: Computers as mindtools for engaging learners in critical thinking. TechTrends **43**(2), 24–32 (1998)
2. Chu, H.C., Hwang, G.J., Tsai, C.C.: A knowledge engineering approach to developing mindtools for context-aware ubiquitous learning. Comput. Educ. **54**(1), 289–297 (2010)
3. Hwang, G.J., Tsai, C.C., Chu, H.C., Kinshuk, K., Chen, C.Y.: A context-aware ubiquitous learning approach to conducting scientific inquiry activities in a science park. Australas. J. Educ. Technol. **28**(5), 931–947 (2012)
4. Prensky, M.: Digital natives, digital immigrants. On the Horizon **9**(5), 1–6 (2001)
5. Black, A.: Gen Y: who they are and how they learn. Educ. Horiz. **88**(2), 92–101 (2010)
6. Maürtin-Cairncross, A.: A glimpse of Generation-Y in higher education: some implications for teaching and learning environments. South African J. High. Educ. **28**(2), 564–583 (2014)
7. Alaeddine, N.I., Parsaei, H.R., Kakosimos, K., Guo, B., Mansoor, B.: Teaching innovation with technology to accelerate engineering students learning. In: Paper Presented at 2015 ASEE Annual Conference and Exposition, Seattle, Washington, 10.18260/p. 24815 (2015)
8. Metros, S.E.: The educator's role in preparing visually literate learners. Theory Into Pract. **47** (2), 102–109 (2008)
9. Gonzalez, J., Pomares, H., Damas, M., Garcia-Sanchez, P., Rodriguez-Alvarez, M., Palomares, J.M.: The use of video-gaming devices as a motivation for learning embedded systems programming. IEEE Trans. Educ. **56**(2), 199–207 (2013)
10. Azuma, R.: A survey of augmented reality. Presence: Teleoperators Virtual Environ. **6**(4), 355–385 (1997)
11. Milgram, P., Kishino, F.: Taxonomy of mixed reality visual displays. IEICE Trans. Inf. Syst. **E77-D**(12), 1321–1329 (1994)
12. Milgram, P., Takemura, H., Utsumi, A., Kishino, F.: Augmented reality: a class of displays on the reality-virtuality continuum. Telemanipulator Telepresence Technol. 2351 (1994)
13. Graham, M., Zook, M., Boulton, A.: Augmented reality in urban places: contested content and the duplicity of code. Trans. Inst. Br. Geogr. **38**(3), 464–479 (2013)
14. Yuen, S., Yaoyuneyong, G., Johnson, E.: Augmented reality: an overview and five directions for Ar in education. J. Educ. Technol. Dev. Exchange **4**(1), 119–140 (2011)
15. Bacca, J., Baldiris, S., Fabregat, R., Graf, S.: Kinshuk: augmented reality trends in education: a systematic review of research and applications. J. Educ. Technol. Soc. **17**(4), 133–149 (2014)
16. Antonioli, M., Blake, C., Sparks, K.: Augmented reality applications in education. J. Technol. Stud. **40**(2), 96–107 (2014)
17. Shirazi, A., Behzadan, A.H.: Content delivery using augmented reality to enhance students' performance in a building design and assembly project. Adv. Eng. Educ. **4**(3), 1–24 (2015)
18. Mejías Borrero, A.M., Andújar Márquez, J.A.: A pilot study of the effectiveness of augmented reality to enhance the use of remote labs in electrical engineering education. J. Sci. Educ. Technol. **21**(5), 540–557 (2012)
19. Odeh, S., Abu Shanab, S., Anabtawi, M.: Augmented reality internet labs versus its traditional and virtual equivalence. Int. J. Emerg. Technol. Learn. **10**(3), 4–9 (2015)
20. Ibanez, M.B., Di Serio, A., Villaran, D., Kloos, C.D.: Experimenting with electromagnetism using augmented reality: impact on flow student experience and educational effectiveness. Comput. Educ. **71**, 1–13 (2014)

21. Gutiérrez, J.M., Meneses Fernández, M.D.: Applying augmented reality in engineering education to improve academic performance & student motivation. Int. J. Eng. Educ. **30**(3), 625–635 (2014)
22. Billinghurst, M., Duenser, A.: Augmented reality in the classroom. Computer **45**, 56–63 (2012)

Usability Evaluation of a Leap Motion-Based Educational Application

Arwa Al-Razooq, Bayan Boreggah, Laila Al-Qahtani and Rabia Jafri

Abstract This paper describes the usability testing conducted to evaluate an educational application for exploring heart anatomies which utilizes the recently introduced Leap Motion (LM) device for hand gesture-based input. The aim of the testing was to identify any usability problems with the LM and the application interface and to assess the potential of gesture-based interaction for educational tools. The test exposed the need for providing demonstrations of required gestures at the interface, basing commands on simple and intuitive single gestures, and designing better icons with clear usage descriptions. It also showed that participants found LM-based interaction highly learnable and enjoyable despite the usability problems they encountered and revealed their willingness and enthusiasm for using educational tools which support gesture-based user interaction in the future.

Keywords Gesture recognition · Gesture-based technologies · Leap motion · Education · Educational software · Usability testing · Usability evaluation · HCI · Human-computer interaction

A. Al-Razooq · B. Boreggah · L. Al-Qahtani · R. Jafri (✉)
Department of Information Technology, College of Computer and Information Sciences, King Saud University, Riyadh, Saudi Arabia
e-mail: rabia.ksu@gmail.com

A. Al-Razooq
e-mail: arwa.alrazooq@gmail.com

B. Boreggah
e-mail: bayan.boreggah@hotmail.com

L. Al-Qahtani
e-mail: layla.alqahtani@gmail.com

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1 Introduction

Newly emerging gesture recognition-based technologies, in conjunction with 3D models, are increasingly being incorporated into educational tools with the aim of facilitating and enriching the learning process. Though this delineates a pressing need to formally evaluate the usability of such systems and develop design recommendations for their interfaces, few studies have been conducted for this purpose to date.

To help fill this gap, we have conducted usability testing for "Form and Function 3D" [1], an educational application for exploring and comparing the anatomy of three animal hearts, which utilizes the recently introduced Leap Motion (LM) Controller [2] (an infrared (IR) sensor-based USB peripheral device that recognizes hand gestures) for input. The study aims to investigate the ease of interacting with the application using LM-based hand gestures and to identify any usability issues with the interface in order to develop design recommendations for this application in particular and similar gesture-based educational applications in general.

The rest of the paper is organized as follows: Sect. 2 provides an overview of studies conducted to evaluate the usability of LM. Section 3 describes the LM device and the "Form and Function 3D" application. Section 4 explains the procedure for conducting the usability tests and analyzing the data. Section 5 reports the test results. Section 6 discusses the findings of the test and the suggested recommendations. Section 7 concludes the paper and suggests some directions for future work.

2 Related Work

The first LM controller was released in the market in 2012 [3]. Since the LM device is relatively new, thus, few usability studies have been conducted on it so far and there exists a need to test it as a 3D interactive control device especially in conjunction with educational tools. Most of the existing usability studies on LM have focused on comparing it to traditional pointing devices such as the mouse.

Seixas et al. [4] carried out a study to test the performance, movement, preferences and comfort of LM for 2D pointing tasks and to compare it with the mouse and touchpad. They also conducted an analysis of the participant postures while using the LM device. They reported that the error rate was three times higher for the LM as compared to the mouse and the touchpad. The analysis of the postures exposed the following problem—termed as the Gorilla Arm Effect—using LM: if the arm is held in an unsupported horizontal position, it starts to feel very heavy over time causing fatigue and pain.

Coelho and Verbeek [5] compared and evaluated the performance times using a mouse and LM when performing single and multi-pointing tasks in a 3D environment. Their study showed that LM surpassed the mouse in single pointing tasks while the converse was true for multi-pointing tasks; they indicate that users' low rating of LM may be due to the accuracy issues associated with LM, as with most

3D input devices, which affect the users' performance time. Another reason may be that most of the participants were biased more towards mouse interaction as compared to LM.

Scicali and Bischoff [6] conducted a study to test if LM outperforms other input devices in a 3D environment. They found out that LM is more useful for 3D programs that need access to all three dimensions at the same time. Also, giving instant visual feedback with each hand gesture to users allows an intuitive and informative control in both simple and complex gestures. Furthermore, users with prior experience with other gesture recognition devices learn significantly faster as compared to those without.

Ehrler et al. [7] compared three different models of interaction using LM. First interaction was imitating the mouse interaction. Second, for each action, they assigned a specific hand pattern. The last interaction used only a single gesture and certain direction to switch between the interaction modes. The participants were unable to remember the patterns in the second interaction model that had many hand patterns. Also, overall the participants were poorly satisfied with the first two interaction models.

Seixas et al. [8] arranged a pre-session where participants tried five LM gestures. Then, they compared between the mouse and the best and worst gestures performed from the users' point of view; the error rate for the two LM gestures was higher than for the mouse. Also, they found that even when the user had no experience using gesture recognition devices, the learning curve was still increasingly fast. LM scored higher on the System Usability Scale than the mouse, indicating better satisfaction. However, the authors point out that this may be caused by the unfamiliarity of the participants with the device, making them more interested in the new technology.

3 Leap Motion Controller and "Form and Function 3D" Application

This section provides a brief description of the LM controller and the "Form and Function 3D" application.

3.1 Leap Motion Controller

Gesture recognition is one of the newly emerging and extensively studied topics in the field of computer science, where the goal is to interpret human gestures that originate from physical motion or state [9]. The LM controller [2] (shown in Fig. 1a) is a USB peripheral device that senses the hands and fingers and follows their movements. It uses two monochromatic IR cameras and three infrared LEDs to observe a roughly hemispherical area, to a distance of about one meter; the LEDs



Fig. 1 **a** Leap Motion controller [2]; **b** Cat's heart anatomy interface from the application [1]

generate IR light and the reflected data collected by the cameras is sent to the host computer via its USB port where it is analyzed by LM software using "complex maths" to recognize various hand gestures [3]. The LM can be used to build applications in various fields such as 3D games, art, edutainment, virtual laboratories, etc.

3.2 "Form and Function 3D" Application

The "Form and Function 3D" is an educational application which is meant to return a sense of space to learning comparative anatomy [1]. It can be used to explore and compare the hearts of three different animals: shark, salamander and cat. The application uses LM to manipulate the heart anatomy in 3D space [1]. Figure 1b shows the cat's heart page which is divided into three sections: animal's name at the top of the page, 3D model of the heart on the right and menu on the left. The menu contains three options: explore, quiz and home. The explore option directs the user to the exploration page, where he/she can choose from different options such as make the heart transparent, show the blood flow and ask for help. The quiz option directs the user to the quiz page where he/she answers various questions about a specific heart anatomy.

The application makes use of the following LM gestures: swipe, rotation and pointing. Figure 2 shows each gesture and how to perform it.

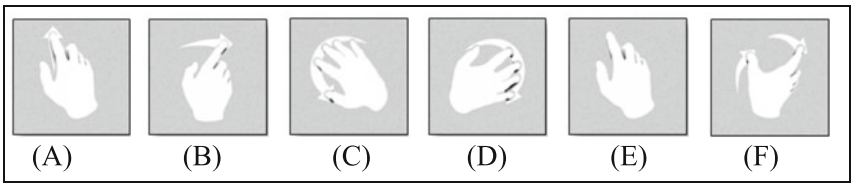


Fig. 2 The gestures needed for the application. **a** Swipe up, **b** swipe right, **c/d** swipe right/left with the whole hand, **e** point and **f** rotate [10]

4 Method

The tests were conducted at the usability lab at the College of Computer and Information Sciences, King Saud University, Riyadh, Saudi Arabia. The setup consisted of a testing room containing the participant and the moderator and an observation room containing two observers. The test procedure was as follows: The participants completed a pre-test background experience and expectations questionnaire, received a five minute training on using LM gestures (on a simple application downloaded from the LM online store), performed two tasks (exploring the cat's heart, taking a quiz on the cat's heart anatomy) and answered a post-test survey and interview designed to elicit their satisfaction and experience using the product. Morae usability testing software [11] was used to record the sessions. Each individual session lasted for about 35 min. Details about the participants, the tasks and the data collection, processing and analysis are provided below.

4.1 Participants

Six female students (ages 19–29 years) enrolled in the Bachelor of Science program at King Saud University Medical College were recruited. The participants will be referred to as P1, P2, P3, P4, P5 and P6 henceforth.

P3, P5 and P6 had no prior experience with gesture-based technologies, P2 and P4 had intermediate experience while P1 had extensive experience. When asked if they were acquainted with LM, three participants indicated that they were familiar with it [P1 and P4 had come across it while surfing on YouTube, while P2 had briefly tried it out at an exhibition (she indicated that she liked the experience and did not face any problem while using it)]. However, the other three participants (P3, P5 and P6) stated that they had never heard about it.

4.2 Task Scenarios

The two main user groups for this application are students and instructors in the medical field. However, our test focused only on the medical students' user group. A persona for a medical student was developed and then two task scenarios were formulated for this persona taking her goals and motivations into account. The first scenario required the participant to visit the cat`s heart page, choose the explore option and try out various transparency and blood flow viewing options while the second scenario required the participant to take a quiz about the cat's heart anatomy. Table 1 shows a detailed breakdown of the tasks for each scenario along with the gestures required to perform them and the maximum expected time for completion.

Table 1 Task lists for both scenarios

Task scenario 1			Task scenario 2		
Task description	Action required to perform	Max time	Task description	Action required to perform	Max time
1.1 Visit the cat's heart main screen	Swipe right/left with the whole hand	30 s	2.1 Visit the cat's heart main screen	Swipe right/left with the whole hand	30 s
1.2 View the cat's heart options	Point with index finger	20 s	2.2 View the cat's heart options	Point with index finger	10 s
1.3 Choose the "Exploring" option	Swipe up	30 s	2.3 Choose the quiz option	Swipe right	10 s
1.4 View explore screen options	Point with index finger	15 s	2.4 Choose the 'start quiz' option	Swipe up	15 s
1.4.1 Choose internal view	Swipe up	30 s	2.5 Pin the part specified in the screen	Point with index finger, then click	10 s
1.4.2 Choose blood flowing option	Swipe left with the whole hand	15 s	2.6 Choose the 'submit' option	Swipe right	15 s
1.4.3 Choose surface view	Swipe up	15 s	2.7 Choose the 'continue' option	Swipe right	10 s
1.5 Choose the help option	Swipe right	10 s	2.8 Choose the help option	Point with index finger	10 s
1.6 Rotate the cat's heart	Rotate	30 s	2.9 Close the cat's heart quiz screen	Swipe up	15 s
1.7 Pin a part of the heart	Point with index finger, then click	20 s	2.10 Go back to home screen	Swipe right/left with the whole hand	30 s
1.8 Close the cat's heart screen	Swipe up	20 s			
1.9 Go back to home screen	Swipe right/left with the whole hand	30 s			

It is important to note that for each scenario, the tasks are described and ordered in the table above according to how they would be performed in an ideal situation; however, the participants were not required to perform the tasks exactly in this order.

Table 2 The data collected to measure usability attributes

Usability attribute	Data collected	Data collection method
Efficiency	• Time to perform a task	• Morae software • Observation
Effectiveness	• Number of tasks completed successfully (within the time limit) • Number of user errors (errors: the user performed the wrong gesture type, task not completed within the expected time)	• Morae software • Observation
Satisfaction	• Participant's answers of the post-test survey questions related to satisfaction with product • A description of observed behavior by participant (frustration, delight, etc.)	• Pre/post-test questionnaire and interviews • Observation

4.3 Data Collection, Processing and Analysis

Video and audio data was recorded via the Morae software to capture the participants' behavior and comments. Both performance and preference data were collected to measure the usability attributes of effectiveness, efficiency and user satisfaction using Morae software as well as direct observation. Table 2 shows the details of the data collected and the methods used for collecting it for each attribute.

The data was processed and analyzed as follows: The raw data from the Morae sessions and the notes and comments from the participants during the post-test interview were compiled. The manually taken notes about the participants' performance were added to the tasks' log through the Morae manager tool. The data was then categorized by type (i.e., performance and preference). The analysis tool of the Morae manager was used to calculate the min, max, mean and standard deviation of the time taken to complete the tasks. The user's comments were correlated with the observation notes and performance data to develop findings and recommendations.

5 Results

In this section, the results of the test for both scenarios are reported. The task scenarios (described in Sect. 4.2) were designed to obtain needed usability criteria measurement information for the LM and the application interface. For testing the LM, we focused on the gestures (shown in Fig. 2) while for the application interface, we focused on the interface design and structure.

5.1 Efficiency

The efficiency was measured by the time needed to perform the tasks. Tables 3 and 4 show the times needed to perform each of the tasks in the first and second scenarios, respectively, along with their means and standard deviations.

For the first scenario, the mean time results in Table 3 show that all tasks, except the first two (T1.1 and T1.2), were performed within the expected time. T1.1 and T1.2 (kindly refer to Table 1 for the task descriptions) also took the longest time to perform while T1.6 took the least time to perform. Some abnormal results include P4 and P6 spending more than a minute to perform task T1.1 and P5 and P6 needing a longer time to figure out where the menu was in task T1.3.

For the second scenario, the mean time results in Table 4 show that all tasks were performed within the expected time. It should be noted that most of the tasks in this scenario are similar to tasks in the first scenario (for example, T1.1 and T2.1 are both for visiting the cat's heart main page) but the participants took significantly less time to perform them in this scenario. Moreover, only one participant used the help option in the first scenario (T1.5), while none of the participants used it in the second scenario (T2.8).

5.2 Effectiveness

We observed that participants experienced the following common difficulties during the test: On the home page, although there were written instructions stating "Swipe left or right to select a species", the participants took some time figuring out how to perform the gesture, and they tried several gestures before figuring it out or asking for help. Three needed assistance to complete that task: one used both of her hands to apply the movement, and the other two were pointing while swiping rather than opening their hands.

Another common mistake was that when selecting an option from the menu by swiping up/down (such as in tasks T1.3, T1.4.1 and T2.3), all participants needed at least two tries since most of them did not realize that they had to move their finger forward/backward and then swipe it. The third common mistake occurred on T1.2: participants mistook the 3D model of the heart shown on the cat page for the menu (Fig. 3a). They tried to rotate and click it before figuring out where the menu actually was; P5 ended up requiring assistance to complete that task. Another error was observed when P6 tried to select the blood flooding option that lies directly over the 3D model of the heart (shown in Fig. 3b)—the 3D model was selected instead of the option. This is obviously a problem with the interface design.

Table 3 Time to perform the tasks in the first scenario

Time (s)	Task											
	T1.1	T1.2	T1.3	T1.4	T1.4.1	T1.4.2	T1.4.3	T1.5	T1.6	T1.7	T1.8	T 1.9
Expected finishing time	30	20	30	15	30	15	15	10	30	20	20	30
Time taken by P1	7.08	6.93	9.42	0.99	9.19	8.42	N/A	N/A	1.74	2.39	3.45	N/A
Time taken by P2	8.41	42.37	3.49	3.62	11.13	5.38	3.88	N/A	6.89	9.82	33.98	N/A
Time taken by P3	10.58	249.95	12.99	5.03	29.03	9.69	2.73	7.3	0.8	N/A	20.7	N/A
Time taken by P4	106.85	1.26	2.77	3.01	36.75	5.11	N/A	N/A	3.92	2.46	5.41	N/A
Time taken by P5	18.86	2.32	101.68	14.86	31.53	40.07	5.22	N/A	2.79	4.78	6.47	4.94
Time taken by P6	78.9	60.4	30.9	1.49	2.86	16.28	2.39	N/A	3.26	2.19	5.26	4.78
Minimum	7.08	1.26	2.77	0.99	2.86	5.11	2.39	7.3	0.8	2.19	3.45	4.78
Maximum	106.85	249.95	101.68	14.86	36.75	40.07	5.22	7.3	6.89	9.82	33.98	4.94
Mean	38.44	60.54	26.87	4.83	20.08	14.16	3.56	7.3	3.23	4.33	12.55	4.86
Standard dev.	43.27	95.9	38.05	5.12	14.03	13.33	1.28	N/A	2.11	3.25	12.24	0.11

Table 4 Time to perform the tasks in the second scenario

Time (s)	Tasks									
	T2.1	T2.2	T2.3	T2.4	T2.5	T2.6	T2.7	T2.8	T2.9	T2.10
Expected finishing time	30	10	10	15	10	15	10	10	15	30
Time taken by P1	2.46	1.2	2.18	1.67	3.82	11.02	4.06	N/A	2.65	N/A
Time taken by P2	12.01	4.06	5.16	16.99	7.93	4.64	14.83	N/A	6.84	7.39
Time taken by P3	23.51	2.62	2.04	4.8	1.22	0.96	3.66	N/A	1.78	N/A
Time taken by P4	31.76	3.64	12.63	2.25	4.45	2.1	3.95	N/A	1.76	2.23
Time taken by P5	2.83	2.3	9.37	2.68	4.5	1.51	3.79	N/A	12.34	12.09
Time taken by P6	3.58	0.98	2.98	4.52	4.27	2.47	5.61	N/A	2.33	8.31
Minimum time	2.46	0.98	2.04	1.67	1.22	0.96	3.66	N/A	1.76	2.23
Maximum time	31.76	4.06	12.63	16.99	7.93	11.02	14.83	N/A	12.34	12.09
Mean time	12.69	2.47	5.73	5.49	4.36	3.78	5.98	N/A	4.62	7.51
Standard dev.	12.38	1.24	4.36	5.77	2.14	3.76	4.39	N/A	4.24	4.06

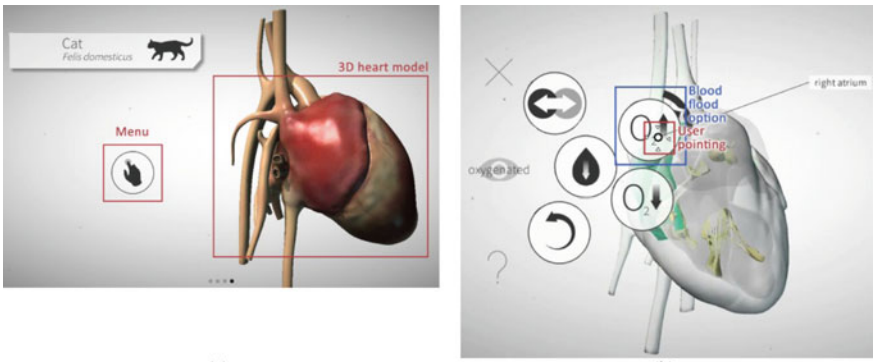


Fig. 3 **a** The menu button and the 3D heart model; **b** P6 trying to choose the blood flooding option [1]

5.3 Satisfaction

To measure the satisfaction, preference data was collected from the pre-test and post-test questionnaires and the post-test interviews as well as direct observation. The results from the questionnaires and the interviews are reported below and the observations regarding these along with their interpretation are discussed in the next section.

Pre-Test and Post-Test Questionnaires. In their responses to the pre-test questionnaire, all participants, except P3, expressed interest in using LM as an assistive tool in their future studies (P3 was reluctant to use LM because she thought it may be hard to interact with as compared to traditional printed materials and would require an investment of time and effort to learn). Moreover, they indicated that they expected the application to have sound effects (such as blood flow and heart beat sounds) and be easy to interact with.

In the responses to the post-test questionnaire, all participants reported that they found the pointing gesture the hardest to perform (they especially delineated having problems in performing this gesture for T2.5: pinning the part specified in the screen). In terms of the ease of learning the various gestures and understanding when to perform them, four participants indicated that they needed a small period of time to comprehend this while the remaining two did not report any problems. Half the participants thought that the overall structure of the application was clear while half did not. As for meeting the user expectations, some users were disappointed to find that the application did not have sound effects of heart beat and blood flow and they suggested adding these as a future improvement to the application. For P3, the system appeared to far exceed her initial low expectations causing her to view it in a much more positive light. All participants stated that learning how to use the application with the LM proved to be easy and, thus, they will use it in their studies if they get the chance to do so. Overall, they all liked both the application and the LM and were willing to recommend these to their friends and families.

Post-Test Interviews. The participants were asked if they felt any pain/physical discomfort—and if so, in which part of the body—after completing the test. Four participants reported feeling no pain at all, one asserted experiencing a slight pain in the shoulder while another indicated that it was quite painful and that her finger hurt afterwards. When asked if they encountered any confusion when using the LM device or the application, four participants explained that it was not clear which gesture they were supposed to use for different tasks (one specifically said that it was not obvious how to perform the swipe gesture) while another participant stated that the options' icons in the application were not clear.

The participants offered several suggestions for improving both the application and LM: For the application, they suggested that providing sound instruction, facilitating the pinning task, including a brief description highlighting the program's main objectives and adding an introductory video that demonstrates and explains the required gestures would be helpful. For the LM, they complained that its detection of gestures was not accurate enough and should be improved. The

participants were also asked about what they liked the best and least about their experience. Trying LM for the first time, using the features included in the application such as 3D images and blood flow, the experience of manipulating objects with the gestures and the easiness of interacting with the application using LM were reported as the most positive while the slow speed of the LM detection and the low accuracy and physical exertion associated with the pinning task were listed as the most negative aspects of their experience by the participants.

6 Discussion

In Table 5, we have included each task for which an error occurred and have listed some possible reasons for its occurrence based on our observation, analysis and the participants' remarks. As mentioned before, the following events were considered as errors: the task was not completed within the expected time, or the participants performed a gesture different from the one required.

The main findings of the test are as follows: Participants with prior experience with other gesture-based technologies performed better than those without. This agrees with results reported in previous studies by Scicali et al. [6] and Seixas et al. [8]. Novice users struggled to understand how to perform the gestures until the moderator intervened; the reason may be—as noted by most participants—that the required gestures were not demonstrated clearly on the interface.

Certain gestures appeared problematic, e.g., selecting an option by swiping right or swiping right with the hand open (as in T1.1, T1.9, T2.1, T2.10)—most users intuitively pointed rather than opening their hand.

Commands requiring a sequence of gestures appeared hard to comprehend: e.g., selecting a specific part of the heart in the quiz (i.e., T2.5), which required pointing and then moving the hand slightly forward, was rated as the most difficult to

Table 5 Source of error analysis

Task	Source of error
1.1 2.1	• No clear demonstration of how to perform the swipe gesture or how to move between pages was provided in the application • Most of the participants were using LM for the first time
1.2 2.2	• The icon (which consisted of a picture of a small pointing hand) was misinterpreted as an instruction rather than as a button to be pointed at • No description of the icons is displayed • There is a significant size disparity between the items on the page: the 3D model of the heart is about half of the page, while the menu option is much smaller (Fig. 3a)
1.3 1.8 2.4 2.8	• The complexity of swipe up/right gesture in the application which was implemented by combining LM pointing then LM swipe up/right gestures made it difficult to perform • The Z depth limitation required to perform the gesture (i.e., moving the finger forward/backward) was not clear

perform; most participants were not able to figure out what gestures were required and, after struggling for some time, started randomly choosing any answer to finish the task.

Though participants stated that the icon designs and descriptions were clear and understandable, but observation showed that five out of the six participants misinterpreted the icon as a guiding picture explaining the gesture to be performed, and mistook the 3D heart model as the button. Also, the need to hover over each icon in order to see its description appeared to cause them some inconvenience. Regarding comfort, two participants reported pain in the shoulder and fingers after performing the two tasks while four asserted feeling no discomfort (however, one of these was observed to change her pose near the end of the test; we believe that this is because she started experiencing the Gorilla arm effect, which is consistent with the outcome reported in the study by Seixas et al. [4]).

Our observation indicated that the participants' complaints regarding the LM's inaccurate detection of gestures stemmed from the high sensitivity of the LM sensor.

The positive change in P3's opinion of the system after using it has promising implications for the adoption of gesture-based technologies even by such individuals who are negatively biased towards these prior to actually experiencing them.

The significant reduction in the average time for those tasks in the second scenario which were identical to tasks performed in the first scenario (e.g., T1.1 and T2.1) indicates a learning curve—participants had learned to do the tasks in the first scenario and were, therefore, able to perform them much faster in the second one. They had also gained some experience handling the LM and this is reflected in the average times for all tasks being within the maximum expected times for the second scenario. These results match those reported by Seixas et al. [4] and appear to indicate that users can learn to interact reasonably well with LM-based applications in a relatively short period of time with a little practice.

Based on the findings above as well as preference data collected from the users, we would make the following recommendations: The gestures required for the interactions should be simple and intuitive. Single gestures are preferable over gesture sequences (e.g., for selecting the heart part in the quiz, instead of requiring pointing and moving the hand forward, the user can be instructed to just keep pointing his/her finger at the part for a couple of seconds). Clear icons and usage guidance should be provided, e.g., adding shadow movement of the required gesture to perform the action to allow the user to follow it easily. For LM, the detection and tracking should be more precise. Some application-specific recommendations would be adding sound and effects (e.g., for the blood flow and heart beat) to enhance the learning experience and expanding the application's content to cover a larger range of heart anatomies.

7 Conclusion

This paper described usability testing conducted to evaluate a LM-based educational application "Form and Function 3D" in order to uncover usability issues with both LM and the application interface and to develop design recommendations for such applications in general and this application in particular. The results of the tests indicate the feasibility of using LM as a control device for educational applications. The tests exposed the need for gesture demonstration, providing commands requiring single, simple and intuitive gestures rather than gesture sequences and better icon design and usage descriptions. They also demonstrated the learnability of the LM and revealed the users' willingness to adopt LM as an interaction device in the future after just a brief period of use. We hope that applying the design recommendations developed in this paper would improve the usability not only of this application but would benefit the usability engineering of similar gesture-based educational tools as well.

For future work, we plan to test this application with the other target user group—i.e., instructors in the medical field—to confirm our findings and uncover other usability issues. We also intend to conduct a study to compare the usability of LM to that of other gesture-based technologies such as Microsoft Kinect [12].

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References

1. Form and Function 3D. Leap Motion App Store. https://apps.leapmotion.com/apps/form-and-function-3d/windows
2. Leap Motion, Inc. https://www.leapmotion.com/
3. Leap Motion. Wikipedia: The Free Encyclopedia. Wikimedia Foundation, Inc.
4. Seixas, M., Cardoso, J., Dias, M.T.G.: The Leap Motion movement for 2D pointing tasks: characterisation and comparison to other devices. In: 5th International Conference on Pervasive and Embedded Computing and Communication Systems (2015)
5. Coelho, J.C., Verbeek, F.J.: Pointing task evaluation of leap motion controller in 3D virtual environment. In: Creating the Difference, Proceedings of the Chi Sparks 2014 Conference, pp. 78–85 (2014)
6. Scicali, A., Bischof, H.-P.: Usability study of leap motion controller. In: Proceedings of the International Conference on Modeling, Simulation and Visualization Methods (MSV) pp. 105–109 (2015)
7. Ehrler, F., Mittempergher, C., Duret, C., Daehne, P., Lovis, C.: Exploratory usability comparison of three interaction paradigms for touchless spatio-temporal manipulations of 3D images using Leap Motion. Swiss Med. Inf. **31** (2015)

8. Seixas, M., Cardoso, J., Dias, M.T.G.: One hand or two hands? 2D selection tasks with the leap motion device. In: Proceedings of the Eighth International Conference on Advances in Computer-Human Interactions, Lisbon, Portugal, pp. 33–38 (2015)
9. Gesture recognition. Wikipedia: The Free Encyclopedia. Wikimedia Foundation, Inc.
10. 30 Free Gesture Icons for Multi-Touch Devices. Mobile Tuxedo.com. http://www.mobiletuxedo.com/30-free-gesture-icons-for-multi-touch-devices/
11. Morae from TechSmith. https://www.techsmith.com/morae.html
12. Microsoft Kinect. https://dev.windows.com/en-us/kinect
13. IWAN Research Group, King Saud University, Riyadh, Saudi Arabia. http://iwan.ksu.edu.sa/en

A Comparative Study on the Usability of Educational Platforms Used by Instructors in the University of the Philippines

Nicole Simon, Brent John Carbonera and Benette Custodio

Abstract A number of learning management systems were launched in an attempt to provide an online educational platform for teachers and students. Considering the perspective of the students, the researchers want to evaluate the usability of Facebook, Google Mail, and University Virtual Learning Environment (UVLe, the official educational website of UP), the most used websites by College of Engineering professors and instructors in University of the Philippines. Each subject was asked to perform a set of six constant tasks which were presented as scenarios. Four usability metrics, specifically, effectiveness, efficiency, learnability, and satisfaction were used for the evaluation. Each metric was measured by one or more parameters. After each task, the subject was asked to answer the Single Ease Question, Perceived Click Affordance Test and System Usability Scale. According to the study, Gmail dominated both Facebook and UVLe in all of the four usability metrics used.

Keywords Usability · Leaning · Management system · Efficiency · Effectiveness · Learnability · Satisfaction · Usability

1 Introduction

In the academic sector, a number of learning management systems (LMS) were launched in an attempt to provide an online educational platform that can bring together teachers and students in a more convenient manner. Online submissions, classrooms, exams, and discussions are just some of the useful online features of these platforms. Some of these even have built-in functions like file organizers and announcement platforms which make both teaching and learning much easier. The professors and instructors in the College of Engineering in University of the Philippines Diliman handle classes using different websites as LMS. These platforms

N. Simon (✉) · B.J. Carbonera · B. Custodio
Department of Industrial Engineering and Operations Research,
University of the Philippines Diliman, 1101 Quezon City, Philippines
e-mail: ndpsimon@gmail.com

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are used for disseminating any kind of information, may it be announcements, presentations or copies of handouts used in class. The inconsistency in the used platforms of the instructors may be affecting the students' learning.

This study will be a significant endeavor in promoting easier and convenient learning and teaching. This will be beneficial to instructors who want to make use of effective learning management systems that cater to the needs of the students. The primary objective of this study is to evaluate the usability of several learning management systems often used by College of Engineering, University of the Philippines Diliman professors and instructors. This study also aims to determine which of these websites is best in terms of different usability metrics and identify which platform dominates in terms of these metrics.

2 Methodology

College of Engineering professors and instructors was surveyed on online platforms they often use in order to disseminate any kind of information to their students. The usability a test was done by 10 subjects (students from College of Engineering). Each subject performed a set of tasks for each of the platforms. However, instead of straightforward tasks, the tasks were presented as scenarios, allowing the user to have freedom on how to complete the goal [3].

Each subject underwent the procedure shown below:

I. Sign-up for an account. Logout then sign in.
II. Select a course and enrol in the class.
III. Upload a file to your instructor.
IV. Send a message to your instructor.
V. Download an attachment.
VI. View an announcement from your instructor.
VII. Perform Perceived Click Affordance Test.
VIII. Answer System Usability Scale.

After each task, the user was asked the Single Ease Question (SEQ) which ranks the difficulty of his/her previously accomplished task and then reset the website to its homepage. Afterwards, the Perceived Click Affordance Test was administered. The tester then presented a paper prototype of the platform home page. From the paper, the tester first asked the subject to inspect all the elements and then asked the subject to underline all items that he/she perceives as clickable and encircle those that he/she does not think as clickable. For the last test, the subject answered 10 questions using the System Usability Scale that aided the group in evaluating the usability of the platform [1].

The analysis was based on four usability metrics identified by Thurow and Mifsud [2]:

1. Effectiveness
    a. Completion rate—Proportion of tasks completed, computed by dividing the total number of completed task by the total number of performed tasks
    Note: A task is considered as not completed when during the task, a user opted to quit in frustration of not knowing how to execute the task.
    b. Number of errors—Total number of errors classified into action and intention
    Action—Error of Omission (committed when a user did not execute a step resulting to an error) and Error of Commission (failing to select the correct item)
    Intention—slip (error without the intention of doing it) and mistake (definite difference in the user's mental model and the website's conceptual model)
2. Efficiency
    a. Time-based efficiency—Average rate of accomplishing a goal
    b. Overall relative efficiency—Ratio between time taken to successfully complete a task and the total time to perform all tasks
3. Learnability
    a. Perceived Click Affordance Test—Proportion of correctly identified clickable and unclickable website elements
4. Satisfaction
    a. Single Ease Question—7-point rating assessing perceived difficulty of task. A lower SEQ rating means an easier task.
    b. System Usability Scale—10-item questionnaire measuring the perceived ease of use of website. SUS is given to users after completing all tasks for a specific website assessing how likely the user will recommend that website to a friend.

3 Results and Discussion

Isolating the critical few will show that Facebook, Gmail and UVLe compose 69.23 % of the websites used by professors and instructors. Hence, the study focused on these three websites.

3.1 Effectiveness

Gmail tops the other two websites with a 100 % completion rate, followed by Facebook with 98.33 % and UVLe with 88.33 %. All users accomplished all the tasks in Gmail, one user failed Task 2 (enrol to a course) in Facebook and a total of

7 task failures occurred in UVLe, two for Task 5 (download attached file) while one each for all the other tasks.

This provides an insight about the complexity of task completions on the said websites. Gmail, having the simplest design, had a perfect completion rate. Despite having knowledge of it, one user failed to see and use the search filter to correctly find the course and ended up quitting the task. UVLe, on the other hand, yielded drastic results with one user failing to accomplish all tasks due to a website error.

The other parameter for this current metric is the number of errors committed by users while accomplishing the tasks for each website. For the action classification, users registered 7, 0, 4 omission errors and 5, 19, 46 selection errors in Gmail, Facebook and UVLe, respectively. However for the intention classification, users registers 8, 7, 8 slips and 4, 12, 42 mistakes for Gmail, Facebook and UVLe, respectively.

Conclusively, users are most prone to committing errors using UVLe, independent of the error classifications. Gmail continues to outperform the two other websites having only 12 cumulative errors for all users. Facebook is not too far away with only 19 errors while UVLe returns dire results with a total of 50 errors, much larger than the two websites combined.

Gmail fails to notify users for required data which increases tendency for omissions. However, its conceptual model is easily deduced from its design causing little deviations from the users' mental models, diminishing tendency for mistakes. On the other hand, the two remaining websites are both dominated by selection errors and mistakes. The largest component of error for both websites comprises of users doing the wrong method in executing the tasks, implying a significant difference between the conceptual and mental models. However, both websites perform well in terms of data validation as inferred from their low number of omissions. In fact, Facebook did not register an error for this category.

3.2 Efficiency

Both make use of several quantities necessary to measure the websites' efficiency.

N = total number of tasks

R = total number of users

n_{ij} = result of task i by user j; if the user successfully completes the task, then $N_{ij} = 1$, if not, then $N_{ij} = 0$

t_{ij} = The time spent by user j to complete task i. If the task is not successfully completed, then time is measured till the moment the user quits the task

All quantities were obtained while the users are executing the tasks.

$$\textit{Time Based Efficiency} = \frac{\sum_{j=1}^{R}\sum_{i=1}^{N}\frac{n_{ij}}{t_{ij}}}{NR} \tag{1}$$

$$Overall\ Relative\ Efficiency = \frac{\sum_{j=1}^{R}\sum_{i=1}^{N} n_{ij}t_{ij}}{\sum_{j=}^{R}\sum_{i=}^{N} t_{ij}} \quad (2)$$

Gmail registered the highest efficiency with a time-based efficiency of 0.067 goals/s while Facebook and UVLe followed with 0.0597 goals/s and 0.0406 goals/s, respectively, owing to the fact that Gmail's homepage is also its inbox wherein all messages, announcements and other necessary information are readily accessible in just one click. On the contrary, Facebook and UVLe has a separate homepage increasing the time it takes to accomplish tasks. For the overall relative efficiency, Gmail once again dominated with 100 % efficiency while Facebook and UVLe trailed with 91 and 79 %, respectively. No time is wasted performing tasks in Gmail since all are fully accomplished.

3.3 Learnability

The results obtained were subjected to statistical analysis using One-Way ANOVA to determine whether the proportion of correctly identified items exhibit a significant difference among websites. Test results are shown in Table 1.

The result yielded a large p-value greater than 0.05 (alpha). Thus, based on the given data, there is no significant difference on the proportion of correctly identified items among the three websites. The results are validated by inspecting the residual plots and further proven using Fisher's Pairwise Comparisons using 95 % simultaneous confidence intervals (Fig. 1).

The result shows that the subjects did not demonstrate different learning of the three websites. This shows that, looking at the perceived clickable and unclickable elements, the design of the three websites does not differ significantly.

3.4 Satisfaction

In order to measure the satisfaction of users, the group utilized two questionnaires—Single Ease Question (SEQ) and System Usability Scale (SUS). SEQ, which measures a user's perceived difficulty of a task, is administered after performing each

Table 1 ANOVA result

ANOVA table					
Source	DF	Adj SS	Adj MS	F-value	P-value
Proportion	2	0.01058	0.005292	0.45	0.640
Error	27	0.31475	0.011657		
Total	29	0.32534			

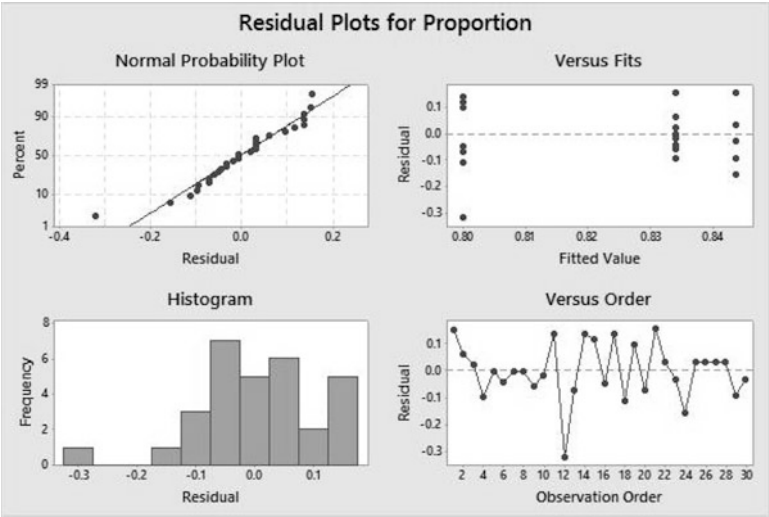


Fig. 1 Residual plots for proportion

task for each website. A lower SEQ rating means an easier task. In contrast, SUS is given to users after completing all tasks for a specific website assessing how likely the user will recommend that website to a friend.

For Task 1 (sign up and sign in), the opposite of the usual trend occurred as UVLe displayed the best results followed by Facebook while Gmail comes up last. This is a result of the privilege given to UP students. Users did not need to sign up for an account in UVLe since they are already entitled to one. Thus, drastically decreasing the number of steps and complexity of the task. Gmail was perceived to have the most difficult signing up process due to numerous details required to set up an account including a phone verification which increases task time and complexity.

The rest of the tasks follow the same pattern. Perceptions of difficulty in accomplishing the tasks in Gmail and Facebook do not exhibit huge differences. Tasks performed using UVLe, on the other hand, are perceived as relatively difficult that can be attributed to its poor design.

For SUS, with Gmail's and Facebook's percentile ranks of 76.75 and 74.25, respectively, both received an SUS Score of B, implying a satisfactory website but room for improvements still remain. With UVLe's percentile rank of 41.5 and an SUS Score of F, the website should prioritize improving its usability.

These results mirror the outcome of previous analyses. A consistent trend of Gmail emerging at the top closely followed by Facebook and UVLe lagging behind both websites is reflected on the satisfaction of users in using the websites.

4 Conclusion

Gmail consistently topped all parameters in all four usability metrics. Consequently, it is recommendable that instructors and professors use this particular website as their online platform to effectively and efficiently manage and disseminate learning to their students, satisfyingly.

Although, UVLe, is lagging behind both websites in majority of the metrics, results showed no significant difference in terms of learnability which is an opportunity for the university to improve its own learning management system

Appendix

Website	Completion Rate (%)
Gmail	100
Facebook	98.33
UVLe	88.33

Number of errors—Action classification

Website	Number of errors (action)—omission/selection
Gmail	7/5
Facebook	0/19
UVLe	4/46

Number of errors—Intention classification

Website	Number of errors (intention)—slip/mistake
Gmail	8/4
Facebook	7/12
UVLe	8/42

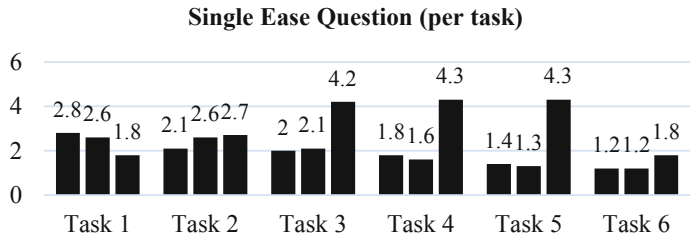
Time-based efficiency

Website	Time-based efficiency (goals/s)
Gmail	0.06652
Facebook	0.05996
UVLe	0.04061

Overall relative efficiency

Website	Overall relative efficiency (%)
Gmail	100
Facebook	91.346
UVLe	79.287

Single Ease Question Results



Single Ease Question (per website)

Website	Single ease question (per website)
Gmail	1.88333
Facebook	1.9000
UVLe	3.18333

System Usability Score

Website	System usability score
Gmail	76.75
Facebook	74.25
UVLe	41.5

References

1. Thomas, N.: Usability Geek. How to Use the System Usability Scale (SUS) to Evaluate the Usability of Your Website—Usability Geek. http://usabilitygeek.com/how-to-use-the-system-usability-scale-sus-to-evaluate-the-usability-of-your-website/
2. Thurow, S.: Marketing Land. Conversion Optimization: Measuring Usability in the User Experience (UX)—Part 2. http://marketingland.com/conversion-optimization-measuring-usability-user-experience-ux-part-2-82839 (2014)
3. Thuseethan, S., Achchuthan, S., Kuhanesan, S.: Usability Evaluation of Learning Management Systems in Sri Lankan Universities (2014)

A Preliminary Study of Using Avatars and Learning Companions for Junior High School Students in Enhancing Studying Chinese Classical Literature

Shao-Jui Hung and Shelley Shwu-Ching Young

Abstract This study focuses on whether preference of virtual avatars and learning companions in a virtual environment has influences on junior high students in learning Chinese classical literature learning. To understand this issue, we collected the target learners' preference of cartoon characters, and images of avatars and learning companies that students like most in the virtual environments. Based on the feedback from the learners, we integrated the preferred emotions into the digital interactive system of the classical literature. Overall, the results of this study show that students have high achievements in learning Chinese classical literature because of their positive emotions toward the virtual avatars and learning companions, and students also have the positive feedback toward the virtual avatars and learning companions. In addition, by the positive emotions toward the virtual avatars and learning companions, students decrease their aversion to classical literature.

Keywords Avatar · Learning companions · Classical Chinese literature learning · Character design

1 Introduction

Digital learning in virtual environment systems is increasingly used to promote meaningful learning outcomes; however, these systems may include systematic biases that produce or reinforce inequitable outcomes in the users [1]. In particular, with the development of artificial intelligence, contemporary virtual learning

S.-J. Hung
Institute of Information Systems and Applications, National Tsing Hua University,
No. 101, Guangfu Road, 30013 Hsinchu, Taiwan
e-mail: shao_jui@hotmail.com

S.S.-C. Young (✉)
Institute of Learning Sciences, National Tsing Hua University,
No. 101, Guangfu Road, 30013 Hsinchu, Taiwan
e-mail: scy@mx.nthu.edu.tw

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environment systems contain either the actions of characters that are controlled by the user, so called the avatar, or characters that are controlled by AI, so called the learning companion. There are a lot of digital learning resources used appearance of avatars or learning companions to enhance the learning achievement in many subjects, such as math [1], biology [2], etc. However, the digital learning resources of classical Chinese literature are very few. Moreover, most of junior high school students have difficulty learning classical Chinese literature, and have aversion toward classical Chinese literature [3].

That is, the main goal of this study is to investigate whether or not the preference of virtual avatars and learning companions in a virtual environment can induce learners' positive emotions, and whether positive emotions can affect cognitive outcomes, as well as affective motivation, user satisfaction, and perception about learning achievement. We hope that the preference of virtual avatars and learning companions could increase achievements in comprehending the classical literature learning, and induce learners' positive emotions to classical Chinese literature.

2 Literature Review

2.1 Customized Avatars and Learning Companions

Appearance of avatar and learning companion has also been shown to increase student's motivation. Baylor and Kim [4] showed that a visible and physically present agent leads to better motivational outcomes than a voice or simply a text box. However, preference of avatar and learning companions' appearance is different to everybody. Bailey et al. [5] found that avatar customization and selection influenced arousal level (measured by skin conductance) and sense of presence (i.e., a psychological state in which people feel virtual objects as actual objects; [6]) in playing a digital environment, such that people who used a customized or selected avatar felt more arousal and reported a higher sense of presence than those who used an assigned avatar. Ratan and Sah [1] found that avatar customization is foreseen to be an important component in the construction of self-identity, particularly the manipulation of hairstyle and hair color. Gender differences and the physical form of the player have also been identified to influence preferences and appearance, as the visual representation of avatars is known to widely vary across game-types. Ratan and Dawson [7] reported greater avatar embodiment during avatar use exhibited weaker physiological responses when watching their avatars receive negative treatment afterward. The preference of avatar and learning companions will affect the emotion of system operating, emotional expressions displayed by virtual characters should therefore be recognizable which is sufficiently guaranteed when posture and facial expression convey the same message simultaneously [8].

2.2 Emotions and Learning

Emotions are a result of an individual's judgment about the world and appraisal of interactions with and in the world [9–12]. In addition, emotions can be described along two dimensions that affect performance, valence (positive negative) and activation (activating deactivating) [13, 14]. Research on negative academic emotions has focused mainly on test anxiety [15]. That is, learners who experience negative emotions take longer reaching mastery levels and perform worse on transfer tasks than learners who experience positive emotions [16]. However, positive emotions support information, communication processing, negotiation, decision-making, creative problem solving, and sorting performance [17, 18]. Furthermore, Positive emotions also improve recall and serve as retrieval cues for long-term memory [19, 20]. Moreover, Learners' metacognitive experiences during learning, such as feeling of difficulty and feeling of confidence are related to positive and negative emotions [21].

3 Purpose and Questions

This study is on the basis of emotion, and we hope junior high students can transfer their positive emotions from avatars and learning companions to classical literature learning, and arouse their learning aspirations. For giving a better learning environment to junior high students, we need to exam the influences by using virtual avatars and learning companions in the virtual learning environment. Afterwards, we can evaluate and fix the virtual avatars and learning companions based on the results of this study. Thus list three questions are presented below to guide this study:

3.1 Question 1

Will Junior high school students have the positive emotions toward the customized virtual avatars and learning companions with their favorite appearance in the digital learning system?

3.2 Question 2

Will Students have better achievements in learning classical literature because of their positive emotions toward the virtual avatars and learning companions?

3.3 Question 3

By the positive emotions toward the virtual avatars and learning companions, did junior high students decrease their aversion to classical literature?

4 Methodology

4.1 Participants

Participants were students in one junior high school which is located in southern Taiwan. There were two classes, 59 students, participated in this study. 34 male and 25 female students, and all of them about over 13 years old.

4.2 Experiment and Design Procedure

The experiment took 1 week in the classical literature class, and was located at the computer classroom. At first, students entered the lab and were instructed to sit and were asked to read assigned classical literature on their textbook in 40 min. After indicating to the researcher that they had finished reading, they were given a test to measure the understanding of the assigned classical literature in 10 min. Afterwards, students were given a tablet computer with a short demographic survey. The researcher first indicated students to finished the tasks at first 10 min, then they were free to operate the system for three classes, 140 min in total. After they finished the tasks, they were given a test to measure the understanding of the classical literature in 10 min, and a satisfaction questionnaire for 40 min.

4.3 Learning Materials Design

To understand this issue, we gathered the target learners' preference of cartoon characters, and collected the images of avatars and learning companies that students like most in virtual environments. Based on the feedback from the learners, we design six kinds of hair styles, faces, and various colors of clothes for users to create their own avatar.

In the system, the user can choose the gender of his or her avatar and adjust the appearance before the avatar entered the virtual learning environment blunt sword and to knock an opponent off a platform. In addition, we also design five categories of learning companions for learners. As the avatar exploring the environment, the selected learning companion will follow behind and guide the leaner to interact with the digital interactive system for learning classical Literature. The learner can choose his or her favorite appearance as their learning companion. As the leaner learns more, the learning companion will continue to grow and evolve to the advanced level.

The camera in the system is placed just slightly on the side of the avatar, providing a third-person perspective. Although the first-person is common in many presence-inducing virtual environments [22, 23], while the third-person perspective

allows the user to see the space near avatar and the avatar itself during operating, and it is useful for solving the learning tasks in the virtual environment.

4.4 Instruments

To investigate the learning effects, a satisfaction questionnaire and an achievement test were administered to the junior high school students. The questionnaire was consisted of two parts, one was about the attitude toward the customized virtual avatars, learning companions, and classical Literature. Participants provided responses on Likert 7-point scale ranging from 1 (strongly disagree) to 7 (strongly agree). Scores were averaged into a composite measure. The other one was to measure the achievements in learning classical literature.

5 Data Analysis and Results

The research data were analyzed and computed software Stata. The results will be presented and discussed in three parts, Junior high school students' attitude toward the customized virtual avatars and learning companions, the students' achievements of learning, and students' emotions toward classical literature.

5.1 Question 1

Will Junior high school students have the positive emotions toward the customized virtual avatars and learning companions with their favorite appearance in the digital learning system?

The total average of this part of questionnaire is 5.45, and the stander deviation is 1.41. Therefore, students are satisfied with the customized virtual avatars and learning companions in total. Table 1 shows the basic statistics of the satisfaction questionnaire of the avatar and the learning companion. About the avatar, "I am satisfied with my customized avatar." not only gets the highest number of students (33 %) in strongly agree, but also gains the most positive answer (71 %) beyond all avatar questions. About the learning companion, "*I am satisfied that the learning companion will continue to grow and evolve to the advanced level in the digital learning system.*" gets the highest number of students (51 %) in strongly agree, and "*I think it is interesting that the learning companion will continue to grow and evolve to the advanced level in the digital learning system.*" gains no negative answer beyond all learning companion questions. Hence, Junior high school students have the positive emotions toward the customized virtual avatars and learning companions with their favorite appearance in the digital learning system.

Table 1 The satisfaction questionnaire of the avatar and the learning companion

Avatar		Strongly agree ↔ Strongly disagree							Ave.	SD
		7 (%)	6 (%)	5 (%)	4 (%)	3 (%)	2 (%)	1 (%)		
1	I am satisfied that I can adjust the appearance of my avatar	30	20	20	20	7	3	2	5.30	1.52
2	I am satisfied with my customized avatar	33	20	18	18	5	6	0	5.30	1.62
3	I am satisfied with the degree of adjusting my avatar	28	21	16	23	8	3	0	5.28	1.45
4	I am found of the system because I can adjust the appearance of my avatar	23	15	20	26	5	8	3	4.87	1.66
5	I like the learning companion I raised in the system	39	10	31	18	2	0	0	5.67	1.21
6	I am satisfied that the learning companion will continue to grow and evolve to the advanced level in the digital learning system	51	13	21	13	0	2	0	5.97	1.23
7	I think it is interesting that the learning companion will continue to grow and evolve to the advanced level in the digital learning system	48	16	21	15	0	0	0	5.97	1.13
8	I will use this system because the learning companion will continue to grow and evolve to the advanced level in the digital learning system	25	23	28	13	8	0	3	5.30	1.45

5.2 Question 2

Will students have better achievements in learning classical literature because of their positive emotions toward the virtual avatars and learning companions?

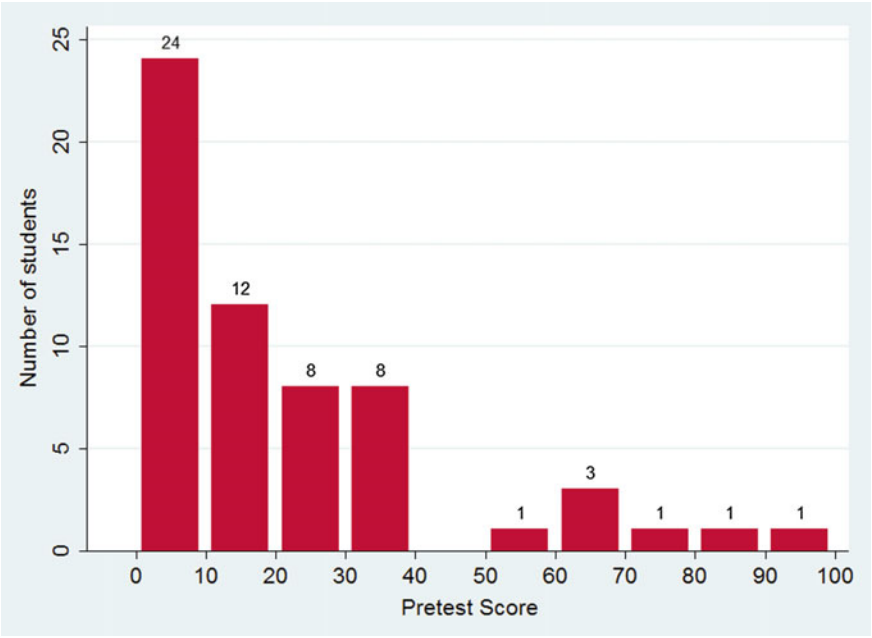


Fig. 1 The histogram of the score range of pre-test

At the part of the understanding of classical literature, Fig. 1 shows the score range of pre-test, and Fig. 2 shows the score range of post-test. The main score distribution of pre-test is at range 0–10, while post-test is at range 90–100. It is obviously that after they operated the system, the main score distribution raised form pre-test range 0–10 to post-test range 90–100. Table 2 shows the basic statistics. According to the match samples, we used paired t test to analyzed the raw data like Table 3, and we got t = −17.4. *Therefore, it means post-test is significant higher than pre-test.* We can say that after three class system operating, junior high school students have better achievements in learning classical literature because of their positive emotions toward the virtual avatars and learning companions.

5.3 Question 3

By the positive emotions toward the virtual avatars and learning companions, did junior high students decrease their aversion to classical Literature?

The total average of this part of questionnaire is 4.91, and the stander deviation is 1.57. Therefore, students have positive emotions toward the influences of the avatar and the learning companion on classical Literature in total. Table 4 shows

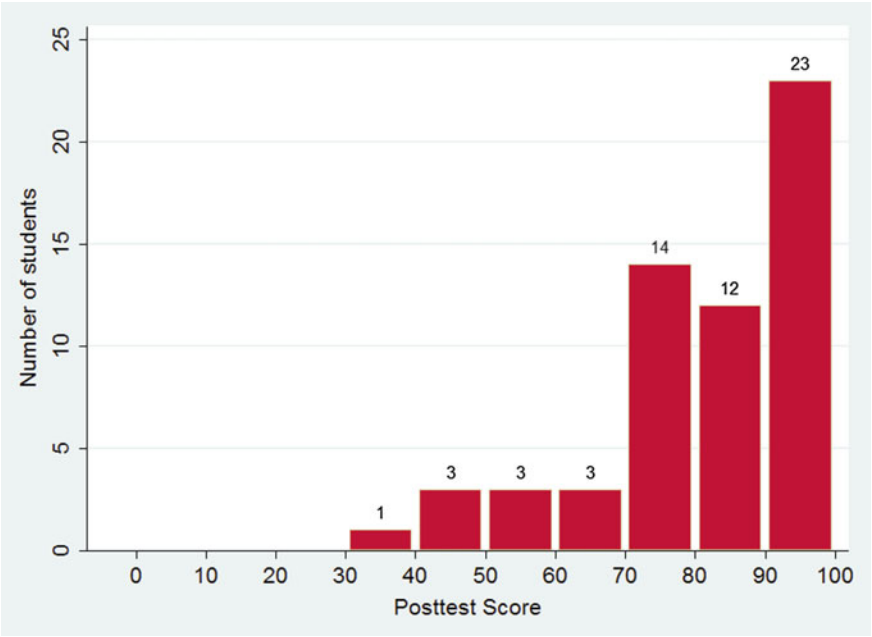


Fig. 2 The histogram of the score range of post-test

Table 2 The basic statistics of pre-test and post-test

	Average	SD	SE	95 % CI lower bound	Upper bound
Pre-test	19.49	23.93	3.12	13.26	25.73
Post-test	82.11	16.25	2.12	77.88	86.34

Table 3 The paired t test of pre-test and post-test

	Average	SD	SE	95 % CI lower bound	Upper bound	t
Pretest–posttest	−62.62	27.64	3.60	−69.82	−55.41	−17.40

the basic statistics of the satisfaction questionnaire of the attitude toward the influences on classical Literature. "*I will practice in the sys-tem because I want my learning companion will continue to grow and evolve to the advanced level.*" gets the highest number of students (26 %) in strongly agree, and "*I think it is interesting that the learning companion will continue to grow and evolve to the advanced level in the digital learning system.*" gains no negative answer beyond all learning companion questions. Accordingly, Junior high school students decrease

Table 4 The satisfaction questionnaire of the attitude toward the influences on classical literature

Learning companion		Strongly agree ↔ Strongly disagree							Ave.	SD
		7 (%)	6 (%)	5 (%)	4 (%)	3 (%)	2 (%)	1 (%)		
1	I will decrease my aversion to classical literature because of my preferences to the avatar in the digital learning system	23	20	15	25	10	8	0	4.97	1.58
2	I will like classical literature because I am found of my avatar in the digital learning system	18	15	15	30	11	5	7	4.57	1.71
3	I think my preferences to the customized avatar will inspire my learning motivation	25	10	26	26	5	3	5	4.93	1.62
4	I will practice in the system because I want my learning companion will continue to grow and evolve to the advanced level	26	26	26	18	0	3	0	5.51	1.24
5	I think raising my learning companion will inspire my learning motivation to classical literature	21	18	26	18	7	8	2	4.98	1.57
6	I will decrease my aversion to classical literature because of my preferences to the learning companion in the digital learning system	18	25	11	26	10	8	2	4.84	1.61

(continued)

Table 4 (continued)

Learning companion		Strongly agree ↔ Strongly disagree							Ave.	SD
		7 (%)	6 (%)	5 (%)	4 (%)	3 (%)	2 (%)	1 (%)		
7	I will like classical literature because I am found of my learning companion in the digital learning system	15	18	16	26	11	8	5	4.54	1.68

their aversion to classical literature because of the positive emotions toward the virtual avatars and learning companions.

6 Summary and Future Study

In sum, the results of this study reveal that students have high achievements in learning classical Chinese literature because of their positive emotions toward the virtual avatars and learning companions. Moreover, students' positive emotions toward the virtual avatars and learning companions increase junior high students' positive emotions to the classical literature. Eventually, the developed digital learning resources in this study on the classical Chinese literature for junior high school students will be beneficial to the targeted learners.

In the future, based on the current result, we will continue to improve the learning system, and further investigate the learning effects in terms of gender issue related to preferences, learning effectiveness, and learning achievements.

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References

1. Ratan, R., Sah, Y.J.: Leveling up on stereotype threat: the role of avatar customization and avatar embodiment. Comput. Hum. Behav. **50**, 367–374 (2015)
2. Plass, J.L., et al.: Emotional design in multimedia learning: effects of shape and color on affect and learning. Learn. Instr. **29**, 128–140 (2014)
3. Hung, S.J., Yang, S.C.: A primary study of the virtual avatars and character design preferences for junior high students in the learning game of classical literatures. In: 2015 International Conference on Educational Innovation, p. 113 (2015)
4. Baylor, A.L., Kim, S.: Designing nonverbal communication for pedagogical agents: when less is more. Comput. Hum. Behav. **25**(2), 450–457 (2009)

5. Bailey, R., Wise, K., Bolls, P.: How avatar customizability affects children's arousal and subjective presence during junk food-sponsored online digital games. Cyber Psychol. Behav. **12**, 277–283 (2009)
6. Lee, E.-J.: Effects of visual representation on social influence in computer mediated communication. Hum. Commun. Res. **30**, 234–259 (2004)
7. Ratan, R., Dawson, M.: When Mii is me: a psychophysiological examination of avatar self-relevance. Commun. Res. (2015)
8. Visschedijk, G.C., Lazonder, A.W., van der Hulst, A., Vink, N., Leemkuil, H.: Modelling human emotions for tactical decision-making games. Br. J. Educ. Technol. **44**(2), 197–207 (2013)
9. Ortony, A., Glore, G.L., Collins, A.: The Cognitive Structure of Emotions. Cambridge University Press, Cambridge (1988)
10. Desmet, P.: Designing emotions. Doctoral dissertation, Delft University of Technology, Delft, The Netherlands (2002)
11. Frijda, N.H.: Moods, emotion episodes, and emotions. In: Lewis, M., Haviland, J.M. (eds.) Handbook of Emotions. Guilford Press, New York (1993)
12. Oatley, K., Johnson-Laird, P.N.: Towards a cognitive theory of emotions. Cogn. Emot. **1**, 29–50 (1987)
13. Pekrun, R.: The impact of emotions on learning and achievement: towards a theory of cognitive/motivational mediators. Appl. Psychol. **41**(4), 359–376 (1992)
14. Russell, J.A.: Core affect and the psychological construction of emotion. Psychol. Rev. **110**(1), 145–172 (2003)
15. Brand, S., Reimer, T., Opwis, K.: How do we learn in a negative mood? Effects of a negative mood on transfer and learning. Learn. Instr. **17**(1), 1–16 (2007)
16. Pekrun, R.: Progress and open problems in educational emotion research. Learn. Instr. **15**(5), 497–506 (2005)
17. Erez, A., Isen, A.M.: The influence of positive affect on the components of expectancy motivation. J. Appl. Psychol. **87**(6), 1055–1067 (2002)
18. Konradt, U., Filip, R., Hoffman, S.: Flow experience and positive affect during hypermedia learning. Br. J. Educ. Technol. **34**(3), 309–327 (2003)
19. Isen, A.M., Shalker, T.E., Clark, M., Karp, L.: Affect, accessibility of material in memory, and behavior: a cognitive loop? J. Pers. Soc. Psychol. **36**(1), 1–12 (1978)
20. Isen, A.M., Daubman, K.A., Nowicki, G.P.: Positive affect facilitates creative problem solving. J. Pers. Soc. Psychol. **56**(6), 1122–1131 (1987)
21. Efklides, A., Petkaki, C.: Effects of mood on students' metacognitive experiences. Learn. Instr. **15**(5), 415–431 (2005)
22. Biocca, F.: The cyborg's dilemma: embodiment in virtual environments. J. Comput.-Med. Commun. **3**, 12–26 (1997)
23. Yee, N., Bailenson, J.N.: The difference between being and seeing: the relative contribution of self-perception and priming to behavioral changes via digital self-representation. Media Psychol. **12**(2), 195–209 (2009)

Gaps Between Practice and Education of Architect—A Study of India

Shweta Saxena, Sandeep Arora and Apurv Shrivastava

Abstract Identifying right tools and techniques to be used for design education remains a challenge for architectural education in India. The study presented in this paper is part of author's ongoing research on design-build studios. Various unresolved issues related to skills and intellect of an architect, demand new pedagogical models to be introduced in the existing pattern. Through observations, experience and literature, easily observable is the lacuna, that the graduates entering the field of architecture find it difficult to relate their design and construction education and real world practice. This paper also proposes specific means for bringing this gap in Indian scenarios of Architectural education. Results of questionnaires responded by several practicing architects and architecture students are presented.

Keywords Architectural education · Architectural profession · Design-build studio

1 Introduction

The formal education of a student starts in an architecture institute where "Architectural Design" holds the core of coursework. Typically based on a studio format, supported by parallel courses in building construction and related sciences, architectural design remains a classroom exercise and design solutions produced have marginal relevance in field. Furthermore, two main domains within the curriculum, namely design and construction are taught as individual courses. Students work on design problem individually and design is represented on sheets and its

S. Saxena (✉) · S. Arora · A. Shrivastava
School of Planning & Architecture, Bhopal, India
e-mail: shweta@spabhopal.ac.in

S. Arora
e-mail: sandeep@spabhopal.ac.in

A. Shrivastava
e-mail: apurv@spabhopal.ac.in

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modeling is done on computers. Rarely, the hands-on experience on the material and construction techniques of the design is seen as integral component of design studio. There is a need to combine various components of practice and education in architecture.

Many design studio models developed in architecture schools around the world tend to combine the skills needed in the practice and education. New models like design-build courses are integral to design education in most of the architectural schools in countries like USA and Europe, but in India, it remains an untapped domain.

2 The Process

The aim of the present study is to find gaps between architectural education and profession and the reasons behind those gaps and to explore various pedagogical approaches within education domain to bridge this gap. The main objectives of the study are:

- To explore various skills required to be an architect.
- To list down the skills acquired during architectural education.
- To find out professional, societal and environmental demands expected to be fulfilled by an architect.
- To find the gaps between the education and profession of an architect.
- To study different patterns in design studios in architectural education.
- To find a suitable pedagogical design model.

Literature study was conducted to understand the evolution of architectural education, organizations working towards improving the quality of education, their goals and philosophies, and relationship between education and practice of architects. To find research gaps particularly in the area of study, other than literature and online sources, questionnaires were prepared for both practicing architects and architecture students in India to find the skills needed to become an architect and to find the gaps between the two realms of education and practice. Those students who completed their practical training of 5–6 months, prescribed in the bachelor of architecture curriculum, were chosen for the survey.

3 Architectural Education—Background

The formal education in arts and architecture started in France in the latter half of the 17th Century. The students in the academy were taught classical arts and architecture of Rome and Greek. The process of getting diploma was linear (Fig. 1), which involved drawing from engravings, plaster casts, live models and imitating

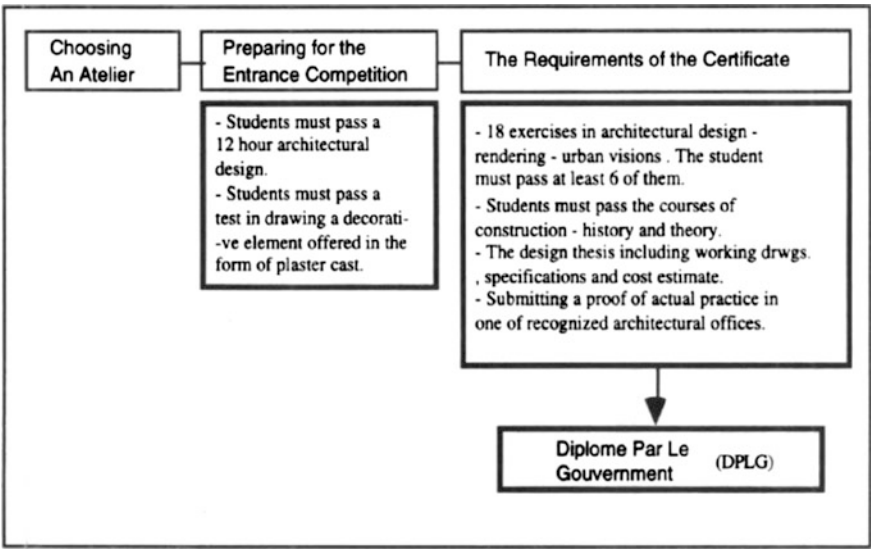


Fig. 1 Educational process of Ecole-des-Beaux Arts. *Source* New trends in Architectural Education, A. Salama

the masters. The architect was the master designer and renderer, who had the understanding of materials, form, construction, economics and sociology during that period. With French revolution at the end of 18th century and later with industrial revolution, the art schools and technical schools became separate realms. Only the tradition of design education remained unharmed, but the revolutions limited its scope to the formal elements, styles and aspects only [9, 12].

'Bauhaus' education (1907–1933), started in response to the technical changes during the industrial revolution. It was different because of its model of workshop teaching, and was rather cyclical (Fig. 2) than linear. Masters of different crafts taught in workshops and students developed products there. The political situation during that period in Germany made masters and architects to move to other countries, especially America [9, 12, 5].

Architectural education in America was not straightforward, rather more complex because the migrants made this continent. The first curriculum of instruction, in the direction of "atelier" system (called "Design Studio") that followed the Beaux —Arts approach was established at M.I.T. under the guidance of French imported instructors. Later on, Bauhaus education was widely applied in contemporary architectural education. Many scholars from different countries: Korea, China, Japan, and Middle Eastern countries, studied in United States and Europe under the influence of the pioneers of the Modern Movement; and they introduced the concepts of this movement in their own countries. Thus, there was a direct impact on design education in architectural schools [9, 12].



Fig. 2 Gropius diagram of Bauhaus pedagogy and curriculum. *Source* Design-build Studio, William Carpenter

Design and build became separate entity in education and practice of architects after the birth of modern architecture.

> The tradition of architecture in India traces back to the Vedic period. The profession and education of Architecture enjoyed a natural autonomy for thousands of years. Architects enjoyed esteem in the society as humanists, scholars, mathematicians, artists, technocrats, designers and master skills persons all blended into one. Architecture is an independent discipline in its own right and existence and draws its inputs from areas of humanities, Fine Arts and technologies transformed into a holistic habitat design discipline [8].

4 Architectural Education—Present Scenario

"At the end of the 20th century, architectural education was significantly reviewed by institutions in the United States, the United kingdom and Australia [13]." Following reports and documents of various professional institutions were studied

to gain the knowledge of present scenario of architectural education and appreciation of future directions. Also reports of organizations and boards based in India are critically analyzed to get the insight of architects' education in study area.

4.1 The National Architectural Accreditation Board—NAAB, USA

According to NAAB, under student performance criteria, students must possess various skills under the following realms:

- Realm A: Critical Thinking and Representation:
  - Being broadly educated
  - Valuing lifelong inquisitiveness
  - Communicating graphically in a range of media
  - Recognizing the assessment of evidence
  - Comprehending people, place and context
  - Recognizing the disparate need of client, community and society
- Realm B: Integrated Building Practices, Technical Skills and Knowledge:
  - Creating building designs with well-integrated systems.
  - Comprehending constructability.
  - Incorporating life safety systems.
  - Integrating accessibility.
  - Applying principles of sustainable design
- Realm C: Leadership and Practice:
  - Knowing societal and professional responsibilities.
  - Comprehending the business of building.
  - Collaborating and negotiating with clients and consultants in the design process.
  - Discerning the diverse roles of architects and those in related disciplines.
  - Integrating community service into the practice of architecture [6].

4.2 National Council of Architectural Registration Boards—NCARB, USA

Following are the knowledge and skills in various areas, suggested in NCARB, that architects need now and will need in the future:

- Communication
- Collaboration
- Professional conduct

- Practice management and project management
- Site Design
- Constructability
- Sustainability
- Technology [11].

4.3 Council of Architecture—COA, India

COA is a body corporate by the Government of India under the provisions of the Architects Act, 1972, enacted by the Parliament of India, which came into force on 1 September 1972. The Act provides for registration of Architects, standards of education, recognized qualifications and standards of practice to be complied with by the practicing architects. The Council of Architecture is charged with the responsibility to regulate the education and practice of profession throughout India besides maintaining the register of architects. For this purpose, the Government of India has framed Rules and Council of Architecture has framed Regulations as provided for in the Architects Act, with the approval of Government of India [2].

5 Observations

Most of the documents stated above have some common themes

- Understanding—The capacity to classify, compare, summarize, explain and/or interpret information.
- Ability—Proficiency in using specific information to accomplish a task, correctly selecting the appropriate information, and accurately applying it to the solution of a specific problem, while also distinguishing the effects of its implementation.
- Diversity
- Creative thinking Skills
- Soft Skills
- Teamwork
- Relationship between education and profession
- Architects' role—towards environment, society etc.

The Council of architecture, India talks about the role of architect and skills required to provide services to the client at various stages of design and construction of a project. It also prescribes subject requirements and number of hours of teaching in each semester, towards the fulfilment of bachelor of architecture degree. But nowhere does COA report mention about quality of education in India.

6 Data Collection

Structured questionnaire was prepared for architects and students of architecture. The aim of the survey was to find out the skills, knowledge and values expected in the architectural practice. Also they were asked about the knowledge, skills and values gained during their architectural education. The questionnaire was sent to 15 architects in India, six of them replied back. Only the students who had completed their practical training of 21 weeks were chosen for students' questionnaire. This questionnaire was sent to 35 students out of which 11 sent their replies.

7 Findings from Primary and Secondary Data

7.1 Skills Required Being an Architect

- Skills
  - Communication—Oral, Graphic
  - Leadership skills
  - Strategic thinking skills
  - Inter-personal skills
  - Presentation skills
- Knowledge of
  - Building Materials
  - Elements and components of building
  - Structures
  - Building Services—Water Supply, Electrical, HVAC, Acoustics etc.
  - Building Construction
  - History, cultural and environmental concerns
  - Tender documents and estimates
- Value
  - Ecology and environment
  - Sustainability—site, water, energy, materials and resources, human value
  - Community/society
  - Professional conduct
  - Context—local, regional, national and global
  - Teamwork and time management
- Role of an architect
  - Making Drawings—sketches, proposal and construction drawings at various levels of design and construction process.
  - Interaction with clients—Identifying client requirements

- Co-ordination with professionals and others—Surveyors, civil engineers, plumbing consultants, technicians, craftsmen, local authorities and regulatory bodies.
- Responsible for—Impact assessment of building, checking budget and schedule, preparing tender applications, writing design and technical reports, specifying the quality and characteristics of materials.

7.2 Gaps in Education and Profession

- Identified Gaps
  - Lack of correlation between theory and practice
  - Lack of service learning
  - Philosophical difference between thinkers and doers
  - Lack of technical proficiencies
  - Lack of hands-on learning
- Identified reasons for gaps
  - Absence of real-world learning in present design studio patterns.
  - "Education of architect gives more privilege to academic excellence [9]."
  - "Building construction education has not been significantly emphasized by mainstream architecture schools [5]."
  - "Wide gap between architectural education objectives and professional expectations [9]."
  - "Reviewing literature on architectural curriculum reveals the lack of design and build opportunities for the students [7]."
  - "The documentation available on design studios rarely talks about the learning in those studios [9]."
  - "Formal education system emphasizes academic excellence [9]."
  - "Subjects related to construction techniques and technologies are mostly delivered in didactic manner [5]."
  - Very few design studios provide connection to 'build' element in architecture education.

8 Patterns in Design Studio

The way of conducting architectural design studios varies in all schools, but these studios remained the core of Architectural education throughout the ages. The study presents various innovative patterns and practices of design studios evolved to address issues identified in the education of architects in India.

8.1 Integral Studio

The experiment of integrating students in a vertical fashion i.e. from 1st year to 3rd year started at School of planning and Architecture Bhopal in winter semester of the year 2013, with the theme 'Basant Bahar'. It was a project based studio where the focus was on bringing outside nature to the inside and vice versa for an office building, which was a live project. Students worked in groups for 10 days on this project and focused mainly on higher productivity of users of an office building by creating comfortable environment inside though green building concepts [10].

The theme of integral studio conducted in May 2015 was 'Learning my Making' where students participated in 10 tracks—Calligraphy, Sketch forms, Studio photography, Lightweight structures, Digital Filmmaking, Analog Printmaking, Design Thinking, Claymation, Ceramics, Origami, Translating Design. All tracks were based on 'hands-on learning'.

8.2 Design Studio at Himgiri Zee University, Dehradun

In the year 2011, a small Design-build studio was conducted by me and Ar. Sandeep Arora. Students of 2nd and 3rd year undergraduate level participated in the studio. They were taken to a nearby small muslim settlement of 8–10 houses, where they participated in the discussion with the residents. Students not only learnt the local vernacular techniques of building habitats using locally available materials, but also tried to find out various needs and problems associated with such type of construction through photographs, videos and sketches. At the end they came out with different design solutions like, a door for the hamlets, partition for baths inside huts, swings and slides for children etc.

8.3 Other Patterns

The design studio pedagogical approach is common in almost all colleges and schools of architecture in India with variations in teaching models. There are various other approaches that have been explored through this study in which students get real-world experience either though hands-on exercises, visiting construction sites and meeting real clients (Fig. 3).

Design Cell in Architecture Schools/Departments. Design cells work as independent architecture offices within the educational set-up. Here students work on various governments or privately sponsored live design projects or research projects related to architecture or allied fields. They work as interns in these cells and are involved in various phases of design and construction of buildings.



Fig. 3 Lighweight Structures, Integral Studio, School of Planning and Architecture, Bhopal, India. Photograph taken by author

Training in Architect's Office. During their 5 years of formal education in architecture, the undergraduate students are required to go for a practical training for a semester. Students work as trainee architects or interns in an architect's office during this semester. They work on ongoing live projects. The scale of the project varies from a small scale residence to a large scale airport.

Training Institutes. There are various institutes in India which work for the empowerment of community in India. Providing training and internship to students of various fields including architecture, over the year, is one of the activities of these centers.

COSTFORD—Centre of Science and Technology for Rural Development. It is a non-profit organization, working towards spreading the technologies and knowledge it has developed for the welfare of society. It offers training programs for students and professionals of related fields in masonry, carpentry, welding, plumbing, electrical works etc. Through these training programs students get direct exposure of the field [1].

Hunnarshaala, Bhuj-Kutch, Gujrat, India. It works towards the empowerment of people to reconstruct their habitat after natural calamities; to produce sustainable and disaster safe habitats and to integrate modern and traditional building knowledge and skills for building design settlement planning, social housing, disaster reconstruction, waste water treatment systems, infrastructure development, etc. [4].

Auroville Earth Institute, Auroville, India. It is an internationally known institute for excellence in earthen architecture. The institute tends to revive traditional skills and integrate vernacular traditions of raw earth with modern technology of stabilized earth [3].

Dharmalaya, Himachal Pradesh, India. It offers following training and workshops for architectural students in India and abroad

- Volunteer and service learning programmes
- Intensive workshops in sustainable living
- Certificate programme in earthen masonry
- Internship in vernacular eco-architecture.

9 Conclusion

To involve architect in the design and construction process of any project, both the education and field experiences play major roles. The scope of this paper has suggested some of the patterns to bring some aspects of profession during the education of architects in India. There are many more approaches that could be explored like design-build studios, collaborative studios etc. Students' learning in these studios could be a topic of research.

References

1. http://www.costford.com/Internship.html. Accessed 2 Nov 2015
2. www.coa.gov.in; http://www.coa.gov.in/practice/practice.htm. Accessed 02 Oct 2015
3. www.earth-auroville.com, www.earth-auroville.com/aboutus. Accessed 8 Oct 2015
4. www.hunnarshala.org, www.hunnarshala.org/aboutus. Accessed 3 Oct 2015
5. Carpenter, W.: Design-Build Studio. Georgia (2010)
6. Conditions for Accreditation NAAB. The National Architectural Accrediting Board Inc., Washington D.C. (2009)
7. Cook, R.: Bridging the Divide Auburn University's Outreach to Alabama's Black Belt. Auburn University Alabama, Office of the Vice President for University Outreach (2004)
8. Deshpande, J.: Architecture education in India. In: 5th International Technology, Education and Development Conference, INTED2011, pp. 2136–2141, Valencia, Spain (2011)
9. Design Education and studio work in the conventional approach. In: Salama A. (ed.) New Trends in Architectural Education: Designing the Design Studio, pp. 39–48. International Standard Book Numbering, United States Agency, New Jersey (1995)
10. Information Brochure 2013–14. School of Planning and Architecture, Bhopal (2013)
11. NCARB Practice Analysis of Architecture. The National Council of Architectural Registration Boards (2013)
12. Ockman, J., Williamson, R.: Architecture School, Three centuries of Educating Architects in North America. The MIT Press Cambridge, Washington D.C. (2012)
13. Wallis, L.H.: Learning By Making Design Build Studios at the School of Architecture at the University of Tasmania, Tasmania Australia (2005)

Part IV
Education Research and Applications

A Preliminary Study of Integrating an Action Role-Playing Game into an Ancient Prose

Pin-Chun Fang and Shelley Shwu-Ching Yang

Abstract The purpose of this research is to build a role-playing game system based on ancient prose to help students increase the understanding of ancient prose through the exploration of the game tasks. Apart from other role-playing games, we put more emphasis on the enhancement of learning interests and integration of different game elements into our system, inclusive of an avatar system, whack-a-mole game, scrabble game, simulation game and so on. In the portion of content design of our game, we designed game elements based on conducting expert interviews in the fields of digital learning and teaching in Chinese and comparisons of different versions of Chinese textbooks. This research divided the system design into two stages: (1) system planning, and (2) system construction. In the first stage, we collected 56 questionnaires from junior high school students to investigate the degree and acceptance of learning ancient prose. In addition, we regarded preferences toward games from students as our design principles. In the stage of system construction, we invited the same students to test our game prototype in order to revise our game system. Moreover, we investigated the interests towards ancient prose from them through evaluation to improve the mechanism of our game. To sum up, this research aims to enhance the knowledge's and learning motivation of ancient prose in the situation of self-directed learning through our system.

Keywords Information and learning technology · Game-based learning · Language learning · Motivation, engagement

P.-C. Fang · S.S.-C. Yang (✉)
Institute of Learning Sciences, National Tsing Hua University,
No. 101, Guangfu Road, 30013 Hsinchu, Taiwan
e-mail: scy@mx.nthu.edu.tw

P.-C. Fang
e-mail: cathy806014@gmail.com

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1 Introduction

In recent years, with the rapid development of science and technology, teaching methods have been changed, such as using a projector for teaching and interacting with media animation by the interactive whiteboard. The advancement of technology has brought a revolutionary change in teaching. Mobile navigation with handle devices, such as smart phones and tablet PC, has become one of tools for capturing knowledge. The improvement of the application software has accelerated the development of applications. The entry barrier of development of mobile applications has been declining gradually; "creativity" and "diversity" are becoming a crucial point in application market.

Digital game-based learning (DGBL) has become a popular learning theory and plays an important role in the field of using technology to assist learning. Although there is much research relative to digital game-based learning, the effectiveness of DGBL is still increasingly being questioned. This research aims to break traditional rules of test-oriented DGBL to develop an action role-playing game based on an ancient prose. In the process of DGBL, learners might not learn regularized knowledge, but they could absorb the truth and thoughts on knowledge from the content. The motivation of this research is to repack the digital game-based learning to arouse learners' motivation of self-directed learning.

This research is dedicated to develop a game-based teaching system mainly based on role-playing game and relative types of games supported an avatar system, whack-a-mole game, scrabble game, simulation game included. First, we came out with some basic requirements of designing a digital game-based learning system based on literature review, and then we summarized reasons why games can appeal players, enhance stickiness, and improve the motivation of playing. Second, we introduced an ancient prose into a game story and designed interactive game mechanisms in a digital way, which aims to enhance the motivation, stickiness and participation of learners toward learning in order to arouse learners' motivation of self-directed learning and discuss learning effectiveness of this system.

2 System Design

2.1 System Framework

The main framework of this system is based on an action role-playing game and the content design takes The Travels of Lao Can-Daming lake published by Kang Hsuan Educational Publishing Corporation as a reference source. Through discussion with experts, we separated the contents into several game points, and then

we expect learners to be an avatar in the game to experience the moral and implication of an ancient prose. In Fig. 1, a system structure chart is composed of the front-end model and back-end model. The front-end model consists of a registration system, an avatar system, trade system, elf-educated system, game-based learning system, and trail tower. The back-end model contains the member management system and the profile system based on Parse database.

The member management system will record data, including student account, passwords, and e-mail when students create a new account. After registration, these activities can be allowed: (1) creating an avatar, (2) buying props to feed an elf, (3) educate an elf to have an attribute, (4) earn money and knowledge from a trail tower. Then students can play three kinds of games, inclusive of a side-scrolling game, scrabble game, and whack-a-mole game according to needs of contents. Figure 2 is a system schematic diagram which describes representation of the elements of a system. The side-scrolling game allows learners to experience the landscape of ancient contents through the game screen. The scrabble game aims to let learners understand relative rules and implication of Chinese antithetical couplets through fixing them right. The whack-a-mole game tries to cultivate the ability of recognizing the representative of a color about a term.

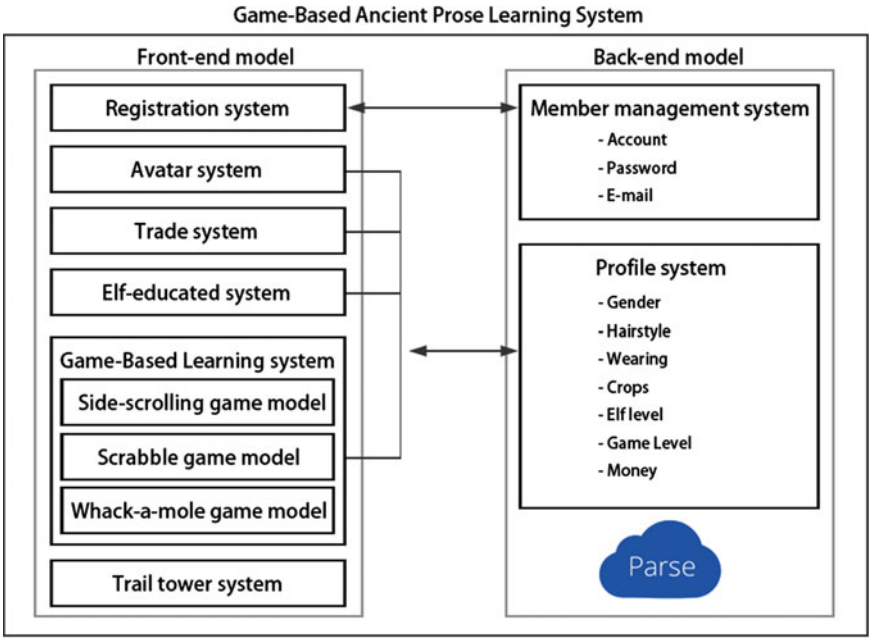


Fig. 1 System structure chart

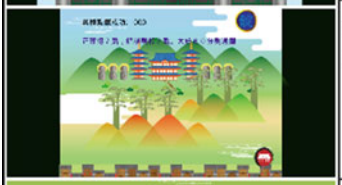
Game screen	Game elements	Course elements
	Main task - Side-scrolling game	Describe the scene of the text- i.e. dilapidated pot with chrysanthemums (老圃黃花)
	Main task - Scrabble game	Understandrelative rules and implication of Chinese antithetical couplets
	Main task - Whack-a-mole game	Describe the color of the text- i.e. fiery-red (紅的火紅)
	Main task - Character conversation	Complemental materials
	Trail tower	Practice
	Elf cabin - Elf-educated	Connect the game and the trail tower in order to inspire students doing practice.

Fig. 2 System schematic diagram

2.2 *User Scenario of This System*

A user scenario is shown in Fig. 3. When learners enter the game, they create a new account first. After logging in, learners can choose their favorite avatar and decorate it, and then they will be guided to watch a story about the world view. After that, they will come into a game map referring to real Daming lake design. Learners can go

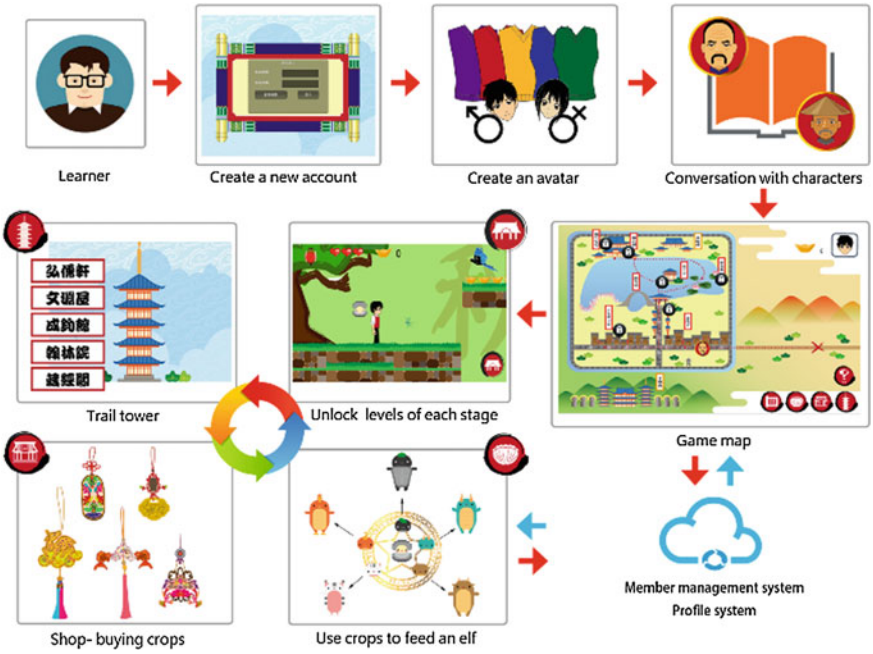


Fig. 3 User scenario

through each stage to explore game tasks to unlock levels according to the description of ancient contents. After completing a level, learners can go to the trail tower to test their learning conditions and earn extra money for buying crops in the shop to feed an elf. Each crop has its own attribute which can change the appearance of an elf. What's more, an elf will accompany learners to beat each level.

3 Results and Discussion

This research contains research stage, content design, system implementation, pilot evaluation, and test. In the research stage, we have delivered questionnaires and interviewed 56 students and teachers from one junior high school in Kaohsiung, Taiwan. The purpose of questionnaires and interview is to understand the degree of familiarity and rejection toward ancient proses and students' preferences of types of games for game system design's reference. As for the content design, we analyzed the contents and teaching elements from three kinds of the most famous publishers in Taiwan and discussed with teachers about the course design for our game content design. This research has spent 4 months developing the system. And then we will conduct a pilot evaluation in the same junior high school to get some ideas and

suggestions from students towards game features and course design. At the same time, we will interview teachers again to modify and complete the system.

4 Conclusions

This research is now in the preparation of pilot evaluation stage. We have constructed a system of integrating an action role-playing game into an ancient prose. The research hopes that learners can experience the pleasure of ancient proses through integration of diverse game elements and course design in order to enhance the motivation and interests of learning and ancient proses. The results from the first stage of questionnaires and interviews indicated that most learners love to play role-playing game. Given that reasons, we chose an action role-playing game to be our target direction and discussed with teachers to come out with the framework of the system. In the future, we expect to get more positive data and reliabilities from the coming pilot evaluation, and then we aim to set up our teaching goal to expand the numbers of ancient proses up to 40 pages. Finally, we truly hope that learners can improve the interests of reading ancient proses to enhance the possibilities of self-directed learning.

The Usage of Social Networking Sites for Education in the Higher Education Context

Sasithon Yuwakosol

Abstract This research aimed to study the usage of social networking sites (SNSs) for education in the higher education context. The survey research consisted of 412 university students who used social networking sites. The main purposes of students for the usage of SNSs in education were to communicate with their classmates and lecturers rather than collaborate on their academic work or use them as a space for information resource sharing. The students revealed that the main advantages they received from using SNSs were easy and convenient ways to search for information, effective ways to contact or communicate with classmates and lecturers, and closer relationship among friends. Regarding the psychological factors that influenced the usage of SNSs in the educational context were subjective norms, compatibility between technology and users, and attitude toward technology. In addition, SNSs usage also correlated with its positive outcome in the context of education. The problems and obstacles the students faced from using SNSs in the educational context were management of time spending online and misinterpretation of non-face-to-face communication.

Keywords Social networking sites · Higher education · Learning

1 Introduction

Social networking site (SNS) is one of the most popular Internet applications and has become part of everyday life of people. SNSs encourage users to create their own network and interact with other users; they can exchange and share information with those who have the same background, interests, and activities. SNSs, therefore, are communities where users are bound together by shared interest. Different from the preceding technology like websites, SNSs allow users to create

S. Yuwakosol (✉)
College of Social Communication Innovation, Srinakharinwirot University,
114 Sukhumvit 23, Bangkok 10110, Thailand
e-mail: Sasithon.y@gmail.com

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and manage content on webpages by themselves as well as create their own network of people with whom they communicate and share information.

These special characteristics of SNSs are conducive to a new way of Internet-based learning, in which students are not just the receivers of information but can also create and share their content. Applying SNSs in teaching and learning, e.g. by communicating knowledge in the forms of articles, videos, photos, and audio to students through the Internet, has been a key strategy for changing the learning process to an online approach, which is not confined to classroom study and lecturers and students can share content via online tool to foster an online community where both lecturers and students can learn simultaneously [1].

University education is a high education level which prepares students for the labor market. In Thailand, the Education Development Plan 2012–2015 [2] had adopted information technology (IT) to upgrade basic and university education and the capacity of Thai workforce to an international standard, especially as the ASEAN Economic Community (AEC) is approaching in 2016.

Accordingly, using SNSs in university education is considered as consistent with the national policy. However, there have been only few studies on application of SNSs in the educational context so far. Realizing such a problem, this research objectives focused on the usage of SNSs for education, studying pattern of SNSs usage in the context of education, factors influencing the usage, outcome of the usage, the relationship between the factors influencing the usage of SNSs for education and the relationship between the usage of SNSs for education and its outcome, and problems and obstacles found in the usage. Findings from this research would be basic information for planning a learning course that can provide both technological and academic knowledge to students. Moreover, since SNSs have become important part in everyday life of Thai people, applying SNSs in education and knowledge seeking would help instill the value of lifelong learning for students and thus lead to a continuously developing and knowledge-based society.

2 Literature Review

2.1 Origin and Characteristics of SNSs

The first social networking site (SNS), SixDegrees.com, was launched in 1997. The difference between SNSs and online communities or other online communication is that SNSs allow users to create content, show their personal information to other users, interact with other users online, and connect with other users in a form of social network [3]. In addition, users can expand their social network by clicking "accept friend request" or "send friend request" to add more people to their online friend list. Friends on social network can be those the users know in real life or only

people they get to know online; once becoming friends on online social network, they will become part of each other's network and can get into the network of the other through their friend lists.

Boyd and Ellison [4] defined SNSs as a web service that allows users to (1) create a page with their personal information, which is called a profile, that can be seen by the public or a limited group of other users, (2) manage the list of other users with whom they want to contact or share information, and (3) see or follow information and activities of other users on their websites. Apart from these shared characteristics, each SNS may have other unique characteristics of its own.

The social networking website quickly became widely accepted and popular among users of various ages. For Thailand, a survey of the Electronic Transactions Development Agency (ETDA) on the Internet usage in Thailand in 2015 showed that Thai people used SNSs the most when compared with other online activities; 82.7 % of them accessed SNSs via smartphones and 45.3 % via personal computers; top three SNSs were Facebook (92.1 %), Line (85.1 %), and Instagram (67.0 %) [5].

2.2 Purposes of SNSs Usage

SNSs encourage users to create their own network and interact with other users; they can exchange and share information with those who have the same background, interests, and activities.

A number of researches examined the purpose of SNSs usage and found that users used SNSs for a great variety of purposes [6–9], which are (1) for communicating and maintaining relationship with friends, family, and people they know as well as making new friends, (2) for entertaining and relaxing, e.g. seeing photos or profiles of other users and reading or posting on timelines or pages of friends, (3) for expressing their identity via activities on the sites, (4) for education, e.g. learning about technology, seeking knowledge, and joining groups of the same interest, and (5) for other social benefits, e.g. to be part of a group of friends or society, to monitor the movement of friends or people they are interested, and to search for news and general information.

2.3 Usage of SNSs in Educational Context

Owing to their nature of informal communication, SNSs have been used as a channel for communication between students and out-of-class communication between students and the lecturers. Studies in many countries showed the use of SNSs as tool for education by students. In South Korea, for example, Kim and Song

[10] conducted a meta-analysis on researches about application of SNSs for education in 2009–2012 and found that SNSs had been widely and variously used by students and they had been a topic of reach since 2010. Most researches focused on the usage of SNSs in university more than other levels of education and Wikipedia was the most popular topic of studies because of its characteristics that support group collaborative work. However, Twitter and Facebook have increasingly been the topics of studies lately.

For Thailand, a research of Chartprasert and Yuwakosol [ibid] studied the usage of Facebook among students. According to the research findings, university students usually used Facebook as a channel for contacting and consulting classmates and lecturers about learning, finding information about their class content, and finding information about university activities. The study also showed that secondary school students used Facebook for submitting homework, sharing content from class, catching up with lectures they have missed, and finding updates on their class lectures; instead of making photocopies of class materials, this group of users would scan or take pictures of class materials, upload them on Facebook, and tag their friends to share the information. Meanwhile, lecturers were found to use Facebook in giving assignment to students, spreading news, and sharing PowerPoint lecture files to students. The lecturers also stated that Facebook helped improve their communication with students, making students more confident to talk with the lecturers about learning, probably because the non-face-to-face communication helped reduce their fear. In addition, an experimental study showed that students assessing the lecturers with high self-disclosure on Facebook as having higher levels of credibility, trustworthiness, and caring than the lecturers with low self-disclosure [11]. Consequently, SNSs could also be used to improve the student-lecturer relationship.

In terms of advantage of SNSs on education, SNSs help facilitate the educational environment that encourages collaborative learning, content producing and sharing, idea exchanging, and communication skill improving, for instance [12]. Mazman and Usluel [13] classified the usage of Facebook for education into three categories: communication, collaboration, and resource/material sharing. The first category, communication, includes activities like communication between students and lecturers in class, class discussion, homework submission, and updating news and announcement about class or the studied subjects. The second category, collaboration, addresses the ability of Facebook group feature that allows students to share idea, homework, or work projects among members of the group, including joining academic Facebook groups of school or university. The last category, resource/material sharing, means users can share and exchange resources and materials with others on the online sphere as SNSs allow users to upload video clips, audio clips, and photos or follow links to external sources of information. This research adopted Mazman and Usluel's categories of SNSs usage in studying.

2.4 Psychological and Social Factors Influencing the Use of Technology

Theories used as a framework in studying psychological factors that influence the usage of SNSs for education were a theory of reasoned action, a theory of planned behavior, a technology acceptance model, and a theory of diffusion of innovation. A social factor that influences the usage of SNSs for education was accessibility to technology.

From a reasoned action theory, Fishbein and Ajzen [14] stated that behavioral intention usually led to behavior; whether or not an individual would show behavioral intention depends on their attitude toward the behavior and social norms and how important was social norms to an individual's behavioral intention depended on a level of the individual's intention to conform with expectation of others. This is applied with the technology acceptance model.

Ajzen [15] subsequently expanded the theory of reasoned action, explaining that behavioral intention did not always lead to behavior and introducing a theory of planned behavior (TPB), which added a factor of perceived behavioral control into the reasoned action theory. The perceived behavioral control means the perceived ease or difficulty of showing particular behavior.

A technology acceptance model was proposed by Davis and Bagozzi [16, 17]. Also influenced by the reasoned action theory, the model specified key factors that lead to acceptance of technology, which were perceived ease of use or the level of an individual's perception that using technology does not require any effort and perceived usefulness or the level of an individual's perception that using technology can improve their work efficiency. Roger [18] called the perceived usefulness 'relative advantage' or the level of an individual's perception that the new innovation is better or worse than existing innovations. Both perceived ease of use and perceived usefulness would lead to attitude toward technology and technology usage behavior. Moreover, Venkatesh and Davis [19] indicated that the more simple and user-friendly is the technology, the more perceived usefulness of users toward the technology. Studies of variables using this model confirmed that perceived usefulness and perceived ease of use could predict behavioral intention toward usage of technology as learning tool [20, 21]. Furthermore, Bagozzi et al. [ibid] believed a person can have a belief about their success and failure in using technology since before or after slight trial of the technology and such a belief would have an influence on their future usage of the technology.

Rogers [ibid], who proposed a theory of diffusion of innovation, defined an innovation as an idea, practice, or thing perceived as new by people. Acceptance of an innovation results partly from characteristics of the innovation, which are its relative advantage or a level of perception that the innovation is more or less useful than existing innovations, complexity or a level of users' perception that the innovation is easy to use and not complex, trialability or an ability of users to try the innovation without having to invest much money or effort, observability or a level of users' perception of results from innovation acceptance, and compatibility or

level of perception that an innovation is compatible with value, past experience, and needs of the user.

Comparing variables of characteristics of an innovation in the three aforementioned theories, there were mentions about similar variables. For example, advantage of technology were found in the variables of relative advantage and perceived usefulness, while complexity of innovation can be compared with perceived ease of use. This research put together and applied different variables concerning the factors influencing the acceptance of technology from the theory of reasoned action, the theory of planned behavior, the technology acceptance model, and the theory of diffusion of innovation, that had been used to explain technology usage behavior to study the factors that influenced the usage of SNSs for education, which are subjective norms, perceived ease of use, perceived usefulness, compatibility between technology and users, and attitude toward technology. The research also investigated a social factor, which is accessibility to SNSs, for it is one of the variables that would affect learning through technology, apart from the students themselves and the lecturers [22].

3 Methodology

The method used in this study is survey. Based on convenience sampling, data were collected from 412 university students of public and private universities who lived in Bangkok and nearby provinces and used social networking sites (SNSs).

3.1 Instrument

The questionnaire consisted of four main sections to explore a relationship between demographic profile and SNSs usage behavior, SNSs usage purposes, patterns of SNSs usage for education, factors influencing SNSs usage for education, and the outcome of SNSs usage for education.

The first section described characteristics of the respondents in terms of gender, age, frequency of Internet usage, frequency of SNSs usage, top SNSs for education and purposes of SNSs usage.

The second section measured educational usage of SNSs by applying the scale of Mazman and Usluel [ibid] which studied the educational usage of Facebook. The scale consisted of three dimensions: communication, collaboration, and resource/material sharing. The Cronbach's alpha reliability coefficient of the 17-item scale was 0.903, which passed the acceptable level of reliability (alpha > 0.70). The Cronbach's alpha value for each dimension was 0.908, 0.760, and 0.796, respectively. Purposes of SNSs usage and patterns of SNSs usage for educational activities were also included in this section.

The third section explored the results of SNSs usage for education. The 11-scaled items were rated on a 5-point Likert scale. The fourth section studied social and psychological factors that could influence the usage of SNSs for education, including subjective norms, perceived ease of use, perceived usefulness, compatibility between technology and users, attitude toward technology, and accessibility to SNSs.

The last section of the questionnaire asked about problems and obstacles in usage of SNSs in the educational context.

A multiple regression model was used for analyzing causal relationship between social and psychological factors, usage of SNSs for education, and the outcome from the usage.

3.2 Participants

The 412 survey samples consisted of 243 females (59 %) and 169 males (41 %). The student had the age range between 17–29 years, including, 17–19 years old (27.4 %), 20–23 years old (69.4 %), 23–25 years old (2.2 %), 26–29 years old (1.0 %). The majority of the respondents were second year students (32 %), third year students (28.6 %), fourth year students (21.8 %), first year students (17.2 %), and only one fifth year student (0.2 %), respectively.

Most of the samples stayed online more than six hours per day in total (28.9 %) and used SNSs for 3–4 h per day (36.2 %). Top three SNSs the samples used for educational purposes were Facebook (92 %), Line (46 %), and YouTube (37 %). Smartphones were a major platform for accessing SNSs. The main purposes of SNSs usage were to communicate with friends and people they knew in the real life (mean = 4.46), to entertain and relax (mean = 4.36), to pass the time (mean = 4.13), and to follow news and information in which they were interested (mean = 4.07).

4 Findings

4.1 Usage of SNSs for Education

The study showed that social networking sites (SNSs) were used for education in three aspects; the top usage was for communicating (mean = 4.08), followed by for collaboration (mean = 3.41) and for sources of information (mean = 3.53) (Table 1).

Looking into each aspect of the usage, regarding the communication purpose, most of the samples used SNSs as a channel for communicating with their classmates (mean = 4.43). Regarding the exchange and creation of information (collaboration), most of the samples used SNSs platforms for discussing and exchanging ideas about content in their class with classmates (mean = 3.71). Regarding the source of

Table 1 Dimension of SNSs usage for education

Dimension of usage	Mean	SD
Communication (total)	4.08	0.713
For contacting classmates	4.43	0.740
For keeping updated on class lectures	4.17	0.883
For keeping updated on news from the faculty or university	4.14	0.802
For receiving or sending files about homework and report assignment with classmates	4.06	0.905
For keeping updated on class lectures from the lecturers	4.04	0.955
For submitting or receiving assignments from the lecturers	3.91	0.934
For consulting the lecturers about learning or other topics	3.83	0.998
Collaboration (total)	3.41	0.731
Using SNSs as a place for discussing and exchanging idea about class content	3.71	0.969
Joining online academic groups of the faculty or university on SNSs e.g. Facebook, Twitter, and Instagram	3.57	0.958
Discussing and exchanging ideas about class content with other general users on SNSs	3.54	1.031
Discussing and exchanging ideas about useful content that is irrelevant to class content	3.46	0.985
Editing or correcting inaccurate academic information concerning their class content on SNSs, e.g. blog, Wikipedia, or Facebook comments	2.79	1.162
Resource/Material Sharing (total)	3.53	0.789
Sharing found video clips, photos, or documents concerning class content with friends and others via Facebook, Twitter, or YouTube	3.59	1.008
Creating and sharing their own video clips, photos, or documents concerning class content with friends and others via Facebook, Twitter, or YouTube	3.58	1.011
Sharing information about sources of knowledge that is useful and relevant to class content with friends and other users via SNSs	3.52	0.975
Searching for useful information relevant to class content from SNSs, e.g. Wikipedia, Facebook, or Flick	3.47	1.012

information, most of the samples used SNSs, e.g. Facebook, Twitter, and YouTube, for sharing videos, photos, or documents concerning content in their class with friends and others (mean = 3.59).

4.2 Results of SNSs Usage in Educational Context

The findings showed that top advantages the samples received from using SNSs were convenience and quickness in searching for information (mean = 4.23), closer relationships with classmates (mean = 4.20), and quickness in receiving news from

Table 2 Outcome of SNSs usage in educational context

Outcome of SNSs usage in the educational context	Mean	SD
makes searching for information easier and more convenient	4.23	0.884
makes you feel closer to classmates	4.20	0.753
makes receiving of news from lecturers and classmates quicker	4.13	0.830
makes group work more efficient	4.04	0.812
helps you complete work more quickly	4.00	0.949
provides additional knowledge for you	3.84	0.878
encourages you to find new academic knowledge from other sources than classroom lectures	3.80	0.949
makes learning more fun	3.68	0.881
makes you feel closer to lecturers	3.67	0.943
makes you feel more confident to ask lecturers a question	3.63	0.901
helps improve your class performance and grades	3.41	1.053

classmates and lecturers (mean = 4.13). On the other hand, the samples received less advantages in terms of closer relationships with lecturers (mean = 3.67), confidence in communicating with lecturers (mean = 3.63), and class performance and grade (mean = 3.41) (Table 2).

4.3 Relationship Between Factors Influencing Usage of SNSs for Education and Relationship Between SNSs Usage for Education and Its Outcome

For the factors that influenced the usage of SNSs for education, the highest score was recorded from compatibility between technology and users (3.98), followed by perceived usefulness (3.96), subjective norms (3.95), attitude toward technology (3.82), accessibility to technology (3.87), and perceived ease of use (3.72) (Table 3).

Analysis of the relationship between the factors influencing usage of SNSs for education using enter regression model showed that the factor that had the most influence on usage of SNSs for education was subjective norms ($\beta = 0.263$), followed by compatibility between technology and users ($\beta = 0.248$), and attitude toward technology ($\beta = 0.136$). These three factors could predict usage of SNSs for education by 49.7 % (Table 4).

In addition, analysis of the relationship between SNSs usage for education and its outcome in the educational context showed that usage of SNSs had an influence on its positive outcome in the context of education ($\beta = 0.538$); the more usage of SNSs for education, the more positive outcome the users received (Table 5).

Table 3 Factors influencing usage of SNSs for education

Factors	Mean	SD
Subjective norms (total)	3.95	0.710
Your classmate uses SNSs to communicate with you about learning	4.14	0.861
Your classmate uses SNSs as sources of learning	4.06	0.845
Your lecturer uses SNSs to communicate with students	3.82	0.877
Your lecturer shares information to students via SNSs	3.81	0.873
Perceived ease of use (total)	3.72	0.819
SNSs are easy to use and not complicated	4.04	0.872
You feel that you are not good at using SNSs	2.63	1.230
Perceived usefulness (total)	3.96	0.690
SNSs make communicating with your classmates about learning easier than before	4.03	0.867
SNSs help you with learning more than other online means	3.97	0.798
SNSs are new, useful innovation for learning	3.91	0.854
Compatibility between technology and users (total)	3.98	0.700
You can utilize SNSs for your learning	3.90	0.804
Using SNSs is usual for people in this generation, including you	4.07	0.804
Attitude toward technology (total)	3.82	0.790
You think using SNSs is a senseless activity	2.57	1.245
You think SNSs are good innovation	4.07	0.819
Accessibility to technology (total)	3.78	0.753
You can access any SNSs almost anytime you want	3.89	0.938
You can access SNSs for free, e.g. at university or via public Wi-Fi	3.79	0.971
You can pay for Internet fee to access SNSs	3.69	0.989

Table 4 Multiple regression analysis of factors influencing usage of SNSs for education

Factors	β	T	Sig.	R^2
Subjective norms	0.486	10.510	0.000*	0.497
Perceived ease of use	−0.007	−0.159	0.874	
Perceived usefulness	0.095	1.696	0.091	
Compatibility between technology and users	0.248	4.402	0.000*	
Attitude toward technology	0.136	2.964	0.003*	
Accessibility to technology	0.049	1.079	0.281	

*Level of statistical significance: $p \leq 0.05$

Table 5 Multiple regression analysis of usage of SNSs for education and its outcome in the context of education

	β	T	Sig.	R^2
Outcome of SNSs usage in the context of education	0.538	12.921	0.000*	0.289

*Level of statistical significance: $p \leq 0.05$

4.4 Problems and Obstacles in SNSs Usage in Educational Context

According to the survey, the problems and obstacles that were found most from SNSs usage were users spending too much time on other irrelevant contents on SNSs (mean = 4.19), increasing self-censorship in posting or communicating online from fear of making bad impression (mean = 3.45), users spending too much money to access the Internet (mean = 3.31); the less found problems and obstacles were source reference and credit giving (mean = 3.17), unreliable content (mean = 3.16), and inability to find the wanted content (mean = 3.14).

5 Discussion

This research aimed to study the usage of social networking sites (SNSs) for education in the context of higher education, given their learning conducive characteristics. SNSs allow users to produce and share content of their own; users are not just the receivers of information but can also create and share their content. Moreover, with their nature of informal communication, SNSs can help improve interpersonal relationship between students and the lecturers.

The findings showed that Facebook was the most popular SNSs among Thai students and most of them used the SNSs for the purposes of maintaining relationship and entertaining and relaxing more than education. This is because those SNSs were designed to support network creation and interpersonal communication, which are different from knowledge sharing sites like Wikipedia or traditional websites of organizations or agencies.

Regarding the usage of SNSs in the context of education, the top usage was as a communicational channel. Students used SNSs for communicating with classmates about the class content, receiving news about the faculty or university, sending or receiving information or files for doing homework or assignment, finding content and lectures from lecturers, and submitting or receiving assignment from lecturers. The less frequently found usage of SNSs in educational context was for sharing or creating content, e.g. exchanging ideas about topics that are useful for learning, though irrelevant to the class content, and solving problems or correcting inaccurate academic content found on SNSs like blog, Wikipedia, or Facebook comments concerning their class content. The usage pattern was related with online activities of students for education. The most frequently found activities of students via SNSs were those relating to communication with classmates, e.g. finding updates on class lectures from classmates, sending or receiving assignment files, and following news and updates about learning. In contrast, the activities students were least likely to involve were those relating to editing or creating content, e.g. creating an online group about the content or useful stuff and editing or correcting inaccurate academic content they found on SNSs.

According to the findings, the usage of SNSs for education can be classified into three categories: communication, information exchange, and resource/material sharing. Analysis showed that students were more likely to use SNSs to communicate with classmates and the lecturers than to exchange and create content or as a source of information. This is because a main purpose of most SNSs users is to contact others, so using SNSs for communicating in the context of education is consistent with their usage of SNSs in everyday life. On the other hand, creating content and exchanging ideas are not extensive activities in the Thai learning culture, thus the less frequent use of SNSs for such purposes in the educational context; students are still just the receivers of information from the lecturers.

The study of the influence of subjective norms, compatibility between technology and users, and attitude toward technology on the usage of SNSs in the educational context showed that usage of SNSs for education by the lecturers and classmates, positive attitude toward SNSs, and perception that usage of SNSs for education is suitable for themselves in the present situations were related to increasing usage of SNSs for education. Thus, lecturers can adopt SNSs with ordinary teaching in class in order to provide students the access to SNSs and help encourage the usage of SNSs for education, which could be advantage for learning. Lecturers can also build a new learning culture where students are the creators and editors of content, to instill values of lifelong learning and improve students' capability in international academic competition.

In contrast, perceived ease of use, perceived usefulness, and accessibility to technology showed no relation with usage of SNSs for academic purpose. This is probably because there are a great variety of SNSs and each has a different level of ease of use; SNSs like blog and Wikipedia require the ability to create academic content, while Facebook requires less of that ability. The second reason concerns perceived usefulness; students may not see usefulness of using SNSs for education more than just a channel for communicating with classmates and the lecturers. The last reason is accessibility to SNSs services; today many educational institutions have provided an Internet-accessible environment for students, thus accessibility to the Internet is not the major problem for using SNSs.

The advantage students received from using SNSs was quickness in working and closer relationship with friends rather than better class performance and closer relationship with the lecturers. This is because the characteristics of SNSs are more of a communicating channel than an educating channel, plus class performance and achievement mainly requires class participation. Yet, SNSs still help facilitate collaboration about learning and class and improve interpersonal relationship between classmates. Lecturers can also build a new learning culture where students are the creators and editors of content, to instill values of lifelong learning and improve students' capability in international academic competition.

Most frequently found problems and obstacles from SNSs usage in the context of education were management of time spent online for education and for entertainment, use of inappropriate speech, misinterpretation of messages in

communicating, and validity and reliability of content. These problems can be solved by developing students' media literacy so they are able to screen online content for use and for more effective learning.

References

1. Eduzones: Progressive OBEC: Driving Thai Education by Social Media. http://www2.eduzones.com/anisada/81488
2. Ministry of Education: Education Development Plan 2012–2015. Bangkok: The Agricultural Co-operative Federation of Thailand. http://www.moe.go.th/moe/upload/news20/FileUpload/26731–5198.pdf
3. Greenhow, C., Robelia, B.: Informal learning and identity formation in online social networks. Learn. Media Technol. **34**,119–140 (2009)
4. Boyd, D., Ellison, N.B.: Social network sites: definition, history, and scholarship. J. Comput.-Med. Commun. **13**(1), 210–230 (2007)
5. Electronic Transactions Development Agency: Thailand Internet User Profile 2015. Department of Index and Survey, Bureau of Strategy, Electronic Transactions Development Agency (Public Organization). Ministry of Information and Communication Technology (2015)
6. Bumgarner, B.A.: You have been poked: exploring the uses and gratifications of Facebook among emerging adults. First Monday **12**(11) (2007). http://firstmonday.org/htbin/cgiwrap/bin/ojs/index.php/fm/article/viewArticle/2026/1897
7. Urista, M., Dong, Q., Day, K.D.: Explaining why young adults use MySpace and Feedback through uses and gratifications theory. Publ. Pacific Asian Commun. Assoc. **12**(2), 215–229 (2008)
8. Smock, A.D., Ellison, N.B., Lampe, C., Wohn, D.Y.: Facebook as a toolkit: a uses and gratification approach to unbundling feature use. Comput. Hum. Behav. **27**(6), 2322–2329 (2011)
9. Chartprasert, D., Yuwakosol, S.: Social Networking Literacy: Usage and Social Issues. Supported by Office of the National Broadcasting and Telecommunications Commission (2012)
10. Kim, S.H., Song, K.S.: A meta-analysis on the application of SNS in education for SMART learning: focusing on Korean Case. Creat. Educ. **3**, 82 (2013). http://dx.doi.org/10.4236/ce.2012.38B018
11. Mazerm, J.P., Murphy, R.E., Simonds, C.J.: The effects of teacher self-disclosure via Facebook on teacher credibility. Learn. Media Technol. **34**(2), 175–183 (2009)
12. McLoughlin, C., Lee, M.J.W.: Social software and participatory learning: pedagogical choices with technology affordances in the Web 2.0 era. In: ICT: Providing Choices for Learners and Learning. Proceedings ASCILITE, pp. 664–675 (2007). http://dlc-ubc.ca/dlc2_wp/educ500/files/2011/07/mcloughlin.pdf
13. Mazman, S.G., Usluel, Y.K.: Modeling educational usage of Facebook. Comput. Educ. **55**, 444–453 (2010)
14. Fishbein, M., Ajzen, I.: Belief, Attitude, Intention and Behavior: An Introduction to Theory and Research. Addison-Wesley, Massachusetts (1975)
15. Ajzen, I.: From intentions to actions: a theory of planned behavior. In: Kuhi, J., Beckmann, J. (eds.) Action-Control: From Cognition to Behavior, pp. 11–39. Springer, Heidelberg (1985)
16. Davis, F.D., Bagozzi, R.P., Warshaw, P.R.: User acceptance of computer technology: a comparison of two theoretical models. Manag. Sci. **35**, 982–1003 (1989). doi:10.2307/24900
17. Bagozzi, R.P., Davis, F.D., Warshaw, P.R.: Development and test of a theory of technological learning and usage. Hum. Relat. **45**(7), 660–686 (1992). doi:10.1177/001872679204500702

18. Rogers, E.: Diffusion of innovation. Free press, New York (2003)
19. Venkatesh,V., Davis, F.: A theoretical extension of the technology acceptance model: four longitudinal field studies. Manag. Sci. **46**, 186–204 (2000). http://www.jstor.org.ludwig.lub.lu.se/stable/10.2307/2634758?origin=api
20. Al-Ammary, J.H., Al-Sherooqi, A.K., Al-Sherooqi, H.K.: The acceptance of social networking as a learning tools at University of Bahrain. Int. J. Inf. Educ. Technol. **4**(2), 208–214 (2014)
21. Lee, K.C., Chung, N.: Exploring antecedents of behavior intention to use Internet banking in Korea: adoption perspective. In: E-adoption and Socio-economic Impacts: Emerging Infrastructural Effects. IGI Global, New York (2011)
22. Volery, T., Lord, D.: Critical success factors in online education. Int. J. Educ. Manag. **14**(5), 216–223 (2000). http://dx.doi.org/26.10.1108/09513540010344731

Part V
Knowledge Creation for the Future

Knowledge Creation and Learning in a Sugarcane Industry in Veracruz, Mexico

Francisco Hernandez Rosas, Katia Angelica Figueroa Rodriguez, Shida Henneberry and Benjamin Figueroa Sandoval

Abstract In order to increase the success in the knowledge creation and learning process among sugarcane growers, a 120-h pilot program was created and implemented for a private factory in the southern region of Mexico. A total of 30 growers and 4 technicians of this private factory were chosen to participate in the program for the adoption of technical innovations. Trainers were asked to prepare their courses considering the following effective educational methodologies when teaching adult learners: self-directed, active, experiential, collaborative, and narrative. Results showed that 40 % of the growers dropped out of the program, technicians were not comfortable during the program as they felt they lost their status, and some innovations could not be implemented adequately due to the lack of available equipment and supplies.

Keywords Training · Outsourcing · Network · Adult education · Innovation

F.H. Rosas (✉) · K.A.F. Rodriguez
Colegio de Postgraduados Campus Cordoba,
Km. 348 Carretera Federal Córdoba-Veracruz Manuel León,
94946 Amatlán de los Reyes, Veracruz, Mexico
e-mail: fhrosas@colpos.mx

K.A.F. Rodriguez
e-mail: fkatia@colpos.mx

S. Henneberry
Master of International Agriculture Program, Oklahoma State University,
Ag Hall 545-B, Stillwater, OK 74075, USA
e-mail: srh@okstate.edu

B.F. Sandoval
Colegio de Postgraduados Campus San Luis Potosi, Iturbide 73,
78600 Salinas de Hidalgo, S.L.P., Mexico
e-mail: benjamin@colpos.mx

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1 Introduction

The world demand for sugar is the primary driver of sugarcane agriculture. Sugarcane is one of the largest crops produced in quantity, making it one of the most important in the world. The strategic relationship between the private factories and the sugarcane growers is a major factor in operating at higher technical and economic efficiency levels in the industry. One of the key problems for the private factories is to make growers improve their level of technical knowledge and to increase their willingness to adopt innovations suggested by them. These innovations can be considered as shared organizational knowledge when both parts contribute to improve the innovation through their own personal experience during its application on the farm.

The relationship between the private factories and the growers is considered contractual agriculture, which is a form of vertical coordination that lies between spot market purchases and integration. The degree of control over the productive process can vary depending on the product. In general, contractual agriculture implies that growers are following production practices established by the purchaser in exchange for guaranteed purchase of their products. Occasionally, the purchaser will provide some technical inputs and services, while growers will provide land and labor. This kind of relationship allows growers to improve their production efficiency, to get market security and access capital (credit), and to have access to technological innovations. On the other hand, the downside of this kind of relationship is that growers might lose their autonomy due to the high level of technical and financial dependence with the industry. Depending on the product, the relationship might have different levels of subordination. For example, the producers of horticultural products have a high level of subordination; their clients have technicians that visit their farms on daily basis to give instructions on crop management, determining the variety to use, the productive process, the use of fertilizers or pesticides, the kind of labor to use and the cropping date. In the end, the payment is made based on the quality of the final product [1].

In the case of the sugarcane industry in the southern region of Mexico, the level of subordination is different because is not as controlling as in the horticulture case previously exposed. To begin with, growers have the capability of choosing whether or not to carry out some activities, such as pest control or harvesting. The plan variety they choose might be suggested, but it is not mandatory. The technicians might visit the growers once or twice and in some cases, if they are in a remote area, they will not get a visit at all. The final payment is made based on the volume they harvested, and quality, which is related to sugar content, is not considered for the final payment. However, there is still a level of subordination due to credit, fertilizers or other products that are given to the growers in order for the private factory to ensure growers will deliver the crop to them.

Under the context exposed above, these growers can be considered part of the private factory, which is an organization, as the profit of the private factory depends on the sugarcane they deliver. Our emphasis is on improving the quality of the

relationship among the private factory and the growers, especially when private factories want to suggest innovations to the growers. Maruta [2] defines organizational knowledge as a collection of knowledge acquired and created by the members of an organization. While organizational learning is considered as a social process involving the members of the organization [3]. In outsourced relationships, providers can have the feeling of not belonging to the organization and thus they are not interested in creating or sharing knowledge with the organization. The same is true for the organization, where providers are considered outsiders that must limit themselves to comply with the company requirements. Still, both might get benefits from sharing knowledge.

The intention of this paper is to propose an alternative form of knowledge creation and learning in an industry that has a contractual agriculture scheme, but where the level of subordination is relatively low.

2 Knowledge Creation Among the Sugarcane Industry and Its Suppliers

General knowledge can be divided into explicit and tacit. Explicit knowledge is articulated in formal language and the tacit knowledge is related to the individual's experience as well as intangible factors such as personal beliefs, perspective, instinct and values. Tacit knowledge can be subdivided into two categories, the pseudo-tacit, which is able to be turned into explicit knowledge, and the genuinely tacit, that cannot be turned into explicit knowledge [2]. Most of the knowledge rural growers in Mexico have has been obtained as tacit knowledge, mainly coming from their parents and their peers. Growers are used to learning under the tacit knowledge form. This means that knowledge gets transferred using analogy, metaphor or demonstration.

Most of the problems regarding technical innovations in the farms arise between the technical personnel of the private factories and the sugarcane growers. The former normally complain that the growers are reluctant to change, especially as they observe that their efforts have been useless when training growers. Training growers normally is done in two ways, the technical personnel tend to use traditional explicit knowledge techniques, and that is, they use formal language in conferences to explain the innovations to the growers. The second way is by demonstration days in a farm that belongs to the private sugarcane industry or to a grower and they make the innovation there. Growers get to go to the place and see the innovation. Still, the explanation that it's given has a formal language.

The duality in the process comes from the fact that the technical personnel has an undergraduate diploma in an agronomy field, whilst the growers normally dropped-out of school. This means they have different mental schemes as for acquiring knowledge. In addition, the information each one has is different. For example, a grower might know the commercial name of what he thinks is the best product for

controlling a plague, but does not know its chemical formulation, something a technician would know. Understanding this situation, new forms for training growers should be explored.

In order for a grower to turn received information into its personal knowledge, first he needs to comprehend that information. This means that this information can be reusable when necessary. The ability to comprehend the information depends on each individual's capacity. The way in which the information is shared also plays a major role. Actually tacit knowledge transfer from an owner to learner can be achieved through the re-creation of knowledge [2].

Considering the differences individuals have for knowledge development, it is necessary to change the strategy by which technicians approach growers. This is especially true under contractual agriculture where the level of subordination is low, since growers are not required to implement the innovations recommended by the private industry.

3 Adults Learning Programs

Traditional training programs in Mexico are developed without considering neither the way knowledge is created nor the adult learners' traits. Adult learners, compared to younger learners, are self-directed and want their previous experience to be recognized and used during the learning process. They have the innate desire to learn, and they value immediate relevant and problem solving-based learning. This leaves the teacher as a facilitator and collaborator of knowledge guiding the learner in an environment for self-directed learning [4].

Two of the most important issues are to understand that adults learn when they are ready and have the need or interest to do it. That is, they learn when they need to understand something new or uncertain to them, and when they have external motivations, such as a better income [5]. Otherwise they might even not attend the course.

Under the consideration of the adult's learning traits, there are several teaching methodologies that can be effective. They can be divided into five categories: self-directed, active, experiential, collaborative, and narrative.

The self-directed methodology considers adults are interested in their learning process and outcomes [6]. Therefore, the adult learner and the instructor share the learning experience. Together the adult learner shares his or her personal experiences with the rest of the class and the instructor helps that tacit knowledge become explicit knowledge. Simultaneously, the instructor might also incorporate some technical principles in order to explain the information that is being presented by the adult learner.

The active learning methodology is intended for learners to develop critical thinking skills and have social support systems available when they are learning.

The main strategy is to encourage learners to be in pairs or small groups to discuss a topic. This will allow them to have more confidence in order to share their thoughts and, in turn, ensure the instructor that the adult learners engage with the topic. In addition, it even gives the instructor time to provide feedback to individual learners, since he or she circulates the room.

The experiential learning methodology is based on the need adult learners have for knowledge to be used in everyday life. Problem solving and role-playing are the most commonly used teaching techniques under this methodology. Instructors might create situations where adult learners have to interpret and analyze information and then present their analysis to the rest of the group [6]. Previous experience helps the adult learners understand the given information, forcing them to make the effort to convert their tacit knowledge into explicit knowledge. At the same time, the instructor is helping the adult learner and the rest of the group organize their ideas properly during the entire process.

Collaborative learning is based on the need adult learners have to find relevance in their studies, since it allows them to talk with their peers during problem-solving events [7]. Collaborative groups require individuals to complete a task by working together in order to achieve shared meaning [8], a skill that some adults have already developed during their working years. The role of the instructor is to follow the work of the team and ensure the participation of all adult learners through the assimilation of knowledge as it is intended.

Narrative learning is a methodology that provides insight into the meaning of past experiences and also raises new interpretations of the past. Biographies of famous and private citizens can be used as part of this different learning approach [6].

4 Program Development

The program was designed as an applied course that focused on sugarcane management, teaching plague control, mechanization, soil management, fertilization, and costs principles in an interdisciplinary and experiential way. The group met once a weak for a 6-h class session, in the mornings for a total of 8 weeks. Instead of being in a classroom, classes were held in sugarcane fields. Attendants were encouraged to observe in the field the plagues and the other technical principles that were being presented to them each week. Instructors were encouraged to use the teaching methodologies described in the previous section. Learning activities included discussion, simulation role-plays, debates and small group application. Two field trips were organized, one to a research center facility and other private factory, and another to Colombia in order to have an international experience. A national institution that gave, at that time, credit to both sugarcane organizations financed the course.

4.1 Participants

Attendants belonged to two organizations of sugarcane growers delivering their product to a private factory in the southern region of Veracruz, Mexico. A list of 40 sugarcane growers were proposed by each organization to attend the course. From both lists, 15 names were retained for the course using the level of centrality of the growers using network-based principles. Of the 30 growers that enrolled on the course, only one was a woman. The same methodology was used for selecting the technicians. A list was provided with the total of names of the technicians that worked for the private factory, only four were retained due to their degree of centrality using the same technique of network analysis [9]. Network analysis was used, since it has been demonstrated to be a useful technique for fostering collective learning [10]. UCINET 6 for Windows and NetDraw 2.087 were used to create and analyze the Network (Fig. 1).

4.2 Course Development

Instructors had to change their teaching strategies from traditional explicit knowledge techniques to teaching methodologies that focus on adults' traits. Growers were enthusiastic about their learning experience as it allowed them to combine their previous tacit knowledge with the instructor's technical knowledge. For example, during the pest control course growers collected insects on the sugarcane

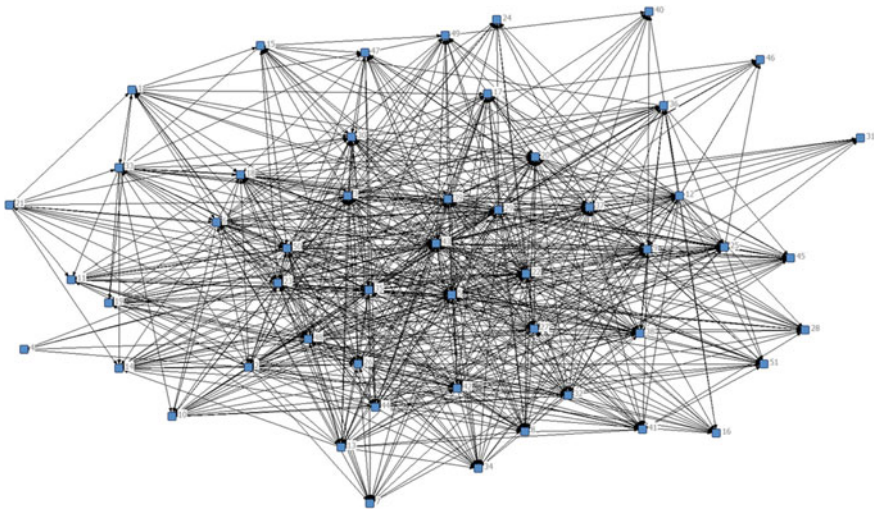


Fig. 1 Network for selecting sugarcane growers to participate in the training course

field and got the opportunity to examine them under the microscope. This gave them a new perspective of the insects, their behavior and the need to control them.

Despite the efforts made by the instructors regarding the focus on the growers' personal interest, as well as their teaching methods, 40 % of the growers dropped out of the program. The main reason for dropping out was the amount of time they devoted to the course, as 8 weeks seemed unbearable. The growers claimed they had to take care of their businesses. Not all growers are exclusively devoted to their sugarcane crop. Sugarcane growers can also have cattle or employ themselves in other activities, which limits their availability. Instructors should consider this matter when training growers.

Another important issue were the geographical distances. Some sugarcane growers did not have a car, so coming to the course was challenging, especially when the location was far away from the private factory or their residences. In some cases, it would take some growers two hours to arrive to the course location. Distances have always been a challenge for training farmers.

"Communicator-grower" (productor difusor) was the name for the sugarcane growers that attended the course. A vest with this distinctive tag was provided to the growers that attended the course. At the end of the course, each grower got an insignia for each session attended. The intention was to make them feel special so that they would relay the information they learned in the course. Rural inhabitants are not used to recognition of their knowledge. For these growers getting the recognition of their effort was new.

A mistake the program made was treating the private factory technicians and the growers the same way. Treating technicians as if they were peers of the growers made the technicians feel as if they were losing their status. Technicians still need to embrace the idea that growers have useful knowledge, and that growers can help teach technological innovations to the rest of the sugarcane growers.

4.3 National and International Experiences

The national experience consisted of growers visiting a research center and another private factory in the center region of the state of Veracruz. During this visit, they were able to listen to further explanations about the innovations they were taught on the course, since these innovations were already implemented at that private factory. Some of the growers had to leave early, as they had business to do at their farms.

Finally, the international experience was in Colombia, which is recognized for its productivity in high sugarcane yields. Only ten of the 30 participants went to this trip. At the beginning of the course, growers were told that they would be chosen to go to the international trip based, on their participation and attendance to the course. Only eight cases met the requirements. For the other cases, the leader of one of the

sugarcane organizations decided to take one place for his son. In the other case, a technician of the private factory that missed almost all of the sessions went to the trip, arguing that his low attendance was related to work overcharge at the private factory.

5 Converting the Experience into Organizational Knowledge

Organizational learning is a set of actions, such as knowledge acquisition, information distribution, information interpretation, and organizational memory, within the organization, in order to influence positive organizational change [11]. Innovations are more easily implemented when the organization is a learning organization. In order to convert the learning experience of the attendants into organizational knowledge, the growers were asked to invite their neighbors and acquaintances to their sugarcane fields to explain the changes made in their production system following the course.

In several cases, growers did not have the equipment or the inputs to carry out the innovation suggested during the course. In order to implement innovations among its suppliers the private factory needs to ensure that all necessities are available, otherwise the effort is useless, and stays as general knowledge with no real implications for increasing the industry's productivity.

6 Conclusions

Knowledge creation is an important factor in order to improve the economic efficiency of the sugar industry, as well as in other industries with contractual agriculture, where the level of subordination is low. Derived from the study, we concluded that for knowledge creation and learning in organizations it is necessary to ensure the provision of goods necessary for the technological innovation implementation. It is also important to work with the private factories personnel to make them feel at ease when faced with new ways to operate their relationships with their suppliers. Regarding the level of participation of growers, the program should be shorter in duration time to ensure a full participation in it. Political issues are important in order to maintain the reputation of the program. Organization learning process among suppliers and the factory in value chains remains a strategic issue for the sugarcane industry as well as for other industries that operate under contractual agriculture schemes.

References

1. Echánove, F., Steffen, C.: Agribusiness and farmers in Mexico: the importance of contractual relations. Geogr. J. **171**(2), 166–176 (2005)
2. Maruta, R.: The creation and management of organizational knowledge. Knowl.-Based Syst. **67**, 26–34 (2014)
3. Rudawska, A.: The learning organization idea in the context of organizational learning and knowledge management. Int. J. Contemp. Manag. **12**(4), 97–109 (2013)
4. Chen, J.C.: Teaching nontraditional adult students: adult learning theories in practice. Teach. High. Educ. **19**(4), 406–418 (2014)
5. Cox, E.: Coaching and adult learning: theory and practice. New Dir. Adult Contin. Educ. **2015** (148), 27–38 (2015)
6. Goddu, K.: Meeting the challenge: teaching strategies for adult learners. Kappa Delta Pi Rec. **48**(4), 169–173 (2012)
7. Davis, H.S.: Discussion as a bridge: strategies that engage adolescent and adult learning styles in the postsecondary classroom. J. Scholarship Teach. Learn. **13**(1), 68–76 (2012)
8. Scherling, S.E.: Designing and fostering effective online group projects. Adult Learn. **22**(2), 13–18 (2011)
9. Wasserman, S., Faust, K.: Social Network Analysis: Methods and Applications (Structural Analysis in the Social Sciences). Cambridge University Press, USA. First published (1994)
10. Mason, W., Watts, D.J.: Collaborative learning in networks. Proc. Natl. Acad. Sci. **109**(3), 764–769 (2012)
11. Noruzy, A., Dalfard, V., Azhdari, B., Nazari-Shirkouhi, S., Rezazadeh, A.: Relations between transformational leadership, organizational learning, knowledge management, organizational innovation, and organizational performance: an empirical investigation of manufacturing firms. Int. J. Adv. Manuf. Technol. **64**(5–8), 1073–1085 (2013)

Different Roles in Leadership Styles in Modern Organization

Tero Reunanen and Jaana Kaitonen

Abstract Today's rapidly changing world has forced leaders to change their leadership styles aligned to the current situation faster than ever. What kind of leadership style should be utilized in modern expert organization? What are leaders' own experiences and can leadership styles somehow been assessed? What have scholars founded regarding leadership styles? This paper examines different situational leadership approaches in order to reveal literature based ontology of leadership styles. Ontology includes leadership styles from over ten well known and tested leadership approaches. Case study is also used to test the possibility for find leaders' styles and development needs via survey. A sample group of leaders answered to the survey with a focus to clarify the leaders of a conscious understanding towards of the working role styles of leadership. The perspective of this paper is the leadership styles and coordination between different leadership approaches. Paper handles results and points out future research suggestion.

Keywords Leadership · Leadership style · Situational leadership · Ontology

1 Leadership Styles

The world is in constant change and chase is changes are continuous, inevitable, dynamic, irreversible, non-deterministic, non-linear and open-ended [1]. An on top of that, time has it's individual situational faces towards everyone and everyone

T. Reunanen (✉)
Turku University of Applied Sciences, Sepänkatu 1, 20700 Turku, Finland
e-mail: tero.reunanen@turkuamk.fi

T. Reunanen
Tampere University of Technology, Pori Campus, Pohjoisranta 11 A, 28100 Pori, Finland

J. Kaitonen
Meyer Turku Ltd., Telakkakatu 1, 20101 Turku, Finland
e-mail: jaana.kaitonen@meyerturku.fi

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possess own time personality [2], leaders should take situationality into serious consideration when thinking about their style in different leadership situations [3].

1.1 Behavioral Approaches

In the early parts of leadership research, the superior characteristic of the behavior is also set to explain leadership as the behavioral theories. The division that Lewin made to *authoritarian, democratic and laissez-faire*—leadership is probably one of the most recognized [4, 5]. Therefore these three styles are first integrated into our ontology. Tannenbaum and Smith provided their own divisions of styles in their leadership style continuum where there are one dimension where area of freedom increases to a boss and diminishes to a follower when moving other direction and second dimension vice versa when moving other direction [6]. This is very close to Lewin's model so this is not included as separate styles into ontology.

Leaders' behavioral differences are found to explain productivity and job satisfaction and in that approach behavioral differences were also divided to three different styles: task-oriented, relationship-oriented and participative leaders [7]. Later broadened by Yukl [8, 9] which is therefore handled later. From Likert we find four different roles to ontology: *exploitative authoritative, benevolent authoritative, consultative and participative* [7]. Behavioral models were further developed to models, where leadership was described in a two-dimensional combination of leaders' task and human orientation. This managerial grid gives different combinations for leader regarding their orientation or concern towards task and human. Five of them are named distinctively [10]. Reddin further developed this managerial grid by adding effectiveness to third dimension [11]. From the combination of these methods two leadership approached ontology is enriched with four styles: *task concern, high task/some human concern, some task/high human concern and human concern.* But in the leadership research history the behavior theoretical models were found to be too simple to explain the whole complex concept of leadership, more integrative models are developed [8, 12].

1.2 Social Interaction Approaches

After behavioral models which focused on leaders' behaviour, social interaction was next where leadership research was concentrated. First of these, situation bound leadership theories, was the contingency model, where leader is fairly unchanged and changes situation if change is needed and styles are limited to task or relationship orientation enhanced by power position with the use of the concept of the least preferred coworker [13, 14]. Since the whole model is rather against leaders' style changes, what is also a point of view which cannot totally be neglected, and human/task orientation is already included, contingency theory styles are not added

to ontology. Situational leadership, where leader changes him/herself regarding followers' capabilities and willingness [15] is an approach which gives next variable to get count on when thinking leadership styles, the followers. The situational leadership rejects "one size fits every follower" approaches to leadership. The leaders need to understand the situation and consider the readiness level of their followers regarding their ability and willingness. Depending on the level of these variables, the leader should apply the most appropriate leadership style according to the given situation [15]. From here we found four different styles to add in ontology. *Directing* (telling), the followers have low willingness and low ability for the task. Leader takes main responsibility for planning, monitoring and supervises everything very accurately. The leader has a high focus on tasks and low relationship focus. *Coaching* (selling) situation emerges when the followers are willing but possess low capability to task. They are motivated but not qualified. Therefore Supervision is still needed but followers have possibility to clarifying questions and are able to give their point of view. Leader is still making the decision in coaching situation. *Supporting* (participating) situation is close to the democratic style of leadership. As followers have low willingness but high capability to task the key work for leader in that situation is motivating and building confidence in people. Key is to facilitate followers own decision making. In *delegating* (observing) style decision-making power and authorization to act is given to the followers. Leader interferes as little as possible. Followers are willing and capable to work mostly by their own and have confidence and commitment this kind of situation Leader is still involved in the decisions if needed, but the process and responsibility of results is passed to follower (s) [15]. From Hersey and Blanchard we are able to adapt these four styles. The next interaction based approach is the path-goal-theory, which emphasizes leaders' behaviour in tasks and relations [16, 17]. This approach styles could be also dived more or less non-violently to two main approaches initiating structure (task behaviors) and the leader's consideration (relationship behaviors). Even that approach is rather interesting approach since it emphasizes leaders' influence in followers' satisfaction motivation and performance [17, 18], these styles are not added as individual aspect to ontology.

Most of social interaction approaches between a leader and a follower can also be roughly divided into three types: (1) the autocratic/authoritarian management, where the leader makes the decisions, keeps discipline and gives orders from above using power alone, (2) the democratic management the workers may participate in the decision-making and the majority uses the decision-making power and (3) the team management everyone can participate in the preparation of decisions and in the continuous evaluation of the results, in other words in the decision-making process. The group aims to find the best solution together [19]. All approaches, which include the approach where followers also have part in decision making, should recognize that all team members are in same position regarding leaders' interaction and how this will affect the decision making. Good explanation for this challenge is found from leader-member exchange theory (LMX) which divides personnel to in-group and out-group regarding how leader sees and treats them [12, 20]. The theoretical name emphasizes the idea that each person expects something

from the other person, and each person also gives and receives something from the other party. LMX-theory is based on the idea that the LMX ratios vary from low to high quality relations. In-group, high quality relations, are characterized by open sharing of information, delegation of tasks and interaction based on trust. The leader and the subordinate trust each other and communication is open, intense, two-way and a mutually beneficial performance. In low-quality relations, out-group, communication relates mainly to carrying out the duties and neither party feels that they receive from the other party all that much [12]. The LMX approach provides three distinctive phases, renamed here to styles, for leaders to leadership style ontology: The *stranger* style, described as the role taking, since leader and the follower don't know each other they are kind of waiting "formal waiting style" and commit to the roles that they have been given by the organization. If everything starts well, leader's confidence towards follower grows. The *acquaintance* style, where working roles don't regulate the behavior of the parties as strictly as in the past. In positive cases' relationship, the mutual trust and respect deepens between leader and follower. *Mature partnership* style, the interaction is on a high level, deep mutual respect, trust and reciprocal sense of duty between the leader and follower exists. People are linked to each other in a way that goes beyond the usual hierarchical relationship [12]. The quality of follower-leader relationship seems to be very important from i.e. the point of view of organizational citizenship behavior. The effective relationship is connected to the satisfaction, commitment, career development and followers' creativity and the efficiency of the leader [21].

1.3 Integrative Approaches

More integrative approaches were introduced after LMX. One of these is transformational leadership, which essence is to make leaders able to inspire followers to "produce far beyond what is expected of them", and changes act as change agents by themselves. Improvement in various ways in terms of organization, leader, followers and adaptive problem solving is highly emphasized. Transformational leadership is crystallized to four I's as leaders' actions in commission to develop followers beyond expectations. *Idealized influence* and *inspirations* are used in envisioning desirable future, setting high standards and shoving determination and confidence as an example for followers to identify. *Intellectual stimulation* is style and tools to help followers to increase their innovativeness and creativeness. *Individualized consideration* is used in order to found out personal developmental needs of followers, needed support and coach actions from leaders. For instance delegation of the assignments could be used as opportunities for followers' growth [22, 23]. The multiple-linkage-model is Yukl's answer to the need for more integrative approach. The model describes how leader behavior influences the performance of individual follower and the leader's work unit. The model identifies six variables: follower's effort, ability and role clarity, organization of work, cooperation and mutual trust, resources and support services, and external coordination.

Yukl links these issues directly to leaders' behavior and shows that leader behavior can influence each of these variables. Yukl divides these behaviours into four distinctive categories: *task-oriented, relations-oriented, change-oriented and external-oriented.* Leaders' task-oriented behavior is focusing on reliable outcomes and work efficiency. Relations-oriented behavior has focus on enhancement of the quality of the working. Change-oriented behavior is focused on increasing collective learning and innovation i.e. organizational learning. Focus on external-oriented behavior is on acquirement of the relevant (external) information and on defense of the interests of the team/organization [9].

As both transformational and multiple linkage approaches are quite heavily prone to development and positive change, many former ones too, but in these it is the most obvious, some point should be studied regarding learning. Amy found that emotionally intelligent communication was one of the most prominent feature when facilitating learning in organizations but authoritarian, defensive and non-communicative behaviours were not (positively) effective [24]. Other well-known approaches include, matching people rightly to jobs, setting goals but allowing enough freedom, support and encourament from leaders, information sharing and openness [25]. LAMPE model is based on an assumption that if an organization's leadership, authority, management, power and external environments are integrated and coherent the organization will prevail. LAMPE approach consists mentioned five main issues enhanced by 29 leadership practices [26]. This model includes most of the different issues and points of view introduced in behavioral, situational and integrated models handled in this paper before, but it is not consisting new distinctive leadership styles for ontology. Team leadership model was presented by Hill in and suggests that especially relationship between team and leader should be inspected. The model emphasizes team performance enhancement by task or relationship behavior or environmental interface improvement [12]. This model has background in earlier team leading research [27, 28], and gives us three distinctive styles to ontology, *task, relational* and *environmental* styles, which are actually called internal and external actions in Hills model.

Substitutes for leadership [29] is an approach which should be included to ontology. Even that it is not directly a leadership approach it has similarities to autocratic and laisses-faire styles. Kerr and Jermier suggest that there are a number of characteristics, which may neutralize the need for leadership. For instance when follower has strong ability, and experience, need for independence or rewards are indifferent to him/her or follower's tasks are routine, clear or provide very intrinsic satisfaction or the organization is very inflexible or work groups are very cohesive. In these cases there might be no need for task or relation leadership just e.g. standard operation procedures or good bonding and commitment of individuals to work and organization [29]. From here we could see that in case of no freedom and just routine it is quite similar to very autocratic or directing styles and in case of very cohesive team, good commitment and intrinsically satisfying job it is near of laisses-faire or delegating styles. Therefore we could *add no need for leadership* style and *need for leadership* styles to ontology.

1.4 Emotional Intelligence

Even that emotional intelligence [30, 31] is not exactly a leadership approach it has some distinctive attributes and behavioral styles which are very usable for leadership and performance of organization. Emotionally intelligent leader creates good and positive atmosphere [31]. According to international studies the impact of management and leadership on the organization's atmosphere is 50–70 % and atmosphere explains 20–30 % of the company's operating results [32]. According to Goleman emotional intelligence is one of the main characteristics of the leader, in terms of effective leadership [31]. There are other definitions too for emotional intelligence, but perhaps one of the best known definitions comes from Salovey's and Mayer's theory [33], and the theory of Goleman [30]. Salovey and Mayer argue that emotional intelligence means the ability to recognize and express your feelings, use the feelings to help thinking, understand how emotions work, as well as manage and regulate them. [33] But since we are building leadership styles ontology Goleman's 5 pillars of emotional intelligence (self-awareness, self-regulation, motivation, empathy and social skill) [30] further developed into six categories of leadership styles are used in this ontology. Goleman's styles *are coercive (commanding), authoritative (visionary), affiliative, democratic, pacesetting and coaching* [31].

1.5 Ontology for Leadership Styles

All of the handled leadership styles are gathered in the Fig. 1. Figure shows leadership approaches in the top row. Every column on figure is hence named either by developer of the approach or by the specified name of approach which ever was found appropriate in every case. Approaches' specific leadership styles are gathered under every column. The figure also shows some levels or degrees of common attributes that approaches handled. These are shown on the left side of figure and are freedom, followers' capacity, leaders' task orientation, leaders' human orientation and complexity of work.

Leadership ontology illustrated in Fig. 1 on does not contain or show all possible styles done in the history of leadership and management research. There are the best known ones are taken into account. And, because of overlapping, it lacks some of the best known approaches' styles which are even handled in this paper. Even though ontology is quite thorough and reveals the essence of leadership and management styles. Ontology comprehends some relations between styles of different approaches, but is nowhere near able to explain all connections, relations or correlations between different approaches. This would need loads of new research and debate between researchers. Despite that it is a conceptual model of how these different approaches to leadership styles could be compared in main similarities and

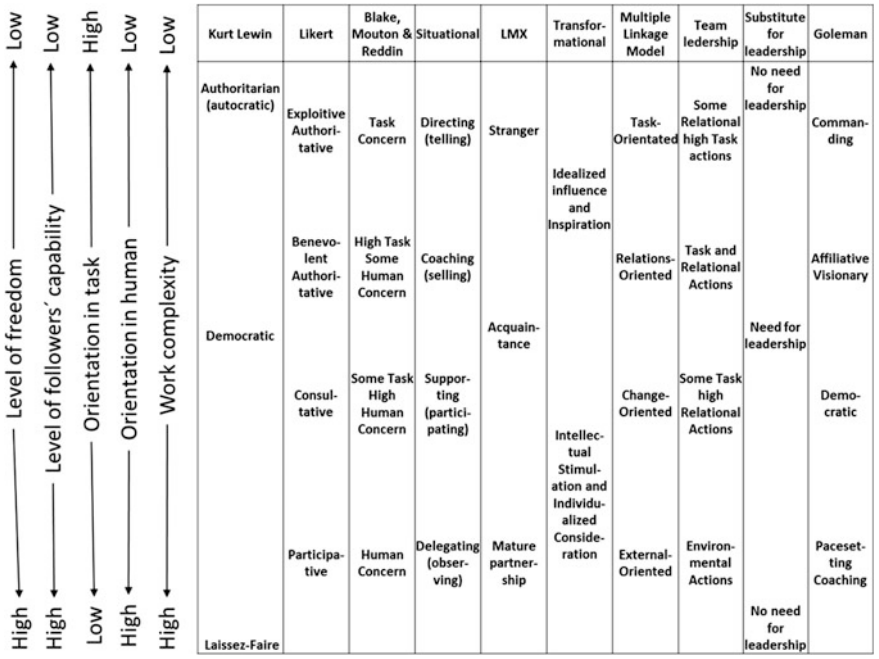


Fig. 1 Leadership styles ontology

differences. Figure 1 can therefore be read so that similar kind of styles are approximately at the same level in a horizontal direction and their relative position is quite correct from the top and bottom of the column. Top and bottom could also be seen to be totalizations.

2 Case Study Research Setting

The main approach and mind set for this study is Evolute approach by, applying ontology engineering, precipitation of meaning, and usage of soft-computing methods and fuzzy logic in order to found out what is and how to cope with uncertainty and imprecision in human knowledge inputs [34]. The purpose of the case study was to test the feasibility of building a survey tool to get reliable results about the respondent's leadership styles. Taking into account all the styles, conducted to the ontology, decided to be a very heavy test case. Therefore the study was executed so that it was limited to consist of only Hersey's and Blanchard's situational leadership styles division to directing, coaching, supporting and delegating. Language of the case study was Finnish i.e. all material e.g. statements, explanation letters, reports were made in Finnish.

2.1 Data Collection

Case study was based on a quantitative research and the research data was acquired by using a survey questionnaire. The statements to the questionnaire were derived to from the situational leadership's four styles' breakdown. Each style was opened to factors and sub-factors creating all together 21 different statements. Also demographic questions were made for possible needs of later statistical purposes. These demographic questions were age, gender, education, leadership experience in years, leadership education and voluntary contact details.

Each statement concerning leadership styles was divided into two parts in order to found out the respondents' present level of certain factor and desired level of the same factor. I.e. Study needed to find out current and target levels. Therefore respondents answered every statement twice. This dual answering was made in order to reveal the respondents' creative tension i.e. the direction and magnitude for development, which they feel. Scale of the answers was Likert scale and all answers were handled as integers between 1 and 6.

The target organization of the research was the Turku University of Applied Sciences Faculty of Technology, Environment and Business. The questionnaire was sent to 27 leader and managers of faculty. All together faculty has over 200 personnel. Eleven answers were got in time.

2.2 Data Analysis

The gathered data was quantitatively analyzed partially using Webropol Professional Statistics tool and Microsoft Excel.

The research data consisted of all 11 respondents' 48 answers: each respondent giving 21 answers of the current state, 21 answers of the target state, and five answers concerning demographic questions, voluntary contact details were not count to this. Therefore study resulted in 528 different data points. In order to find out whether the creative tension, gap between current status and target status, was exciting a correlation gap variable was calculated from every answer. Demographic data as gender and accomplished leadership courses and certifications were not used in this study, but they were gathered due to possible future study.

2.3 Results

The results of the case study were partly ambiguous, expected, surprising and interesting. Figure 2 shows the distribution of the survey responses on the leadership styles. The chart in figure has been modified in order to achieve a better visualization of results. Even that in survey statements were possible to have only

positive integers, from 1 to 6, in Fig. 2 responses "totally disagree", "disagree" and "partly disagree" are given a negative value, and the responses "partly agree", "agree" and "totally agree" are given a positive value. The extreme are thus the values −3 ("totally disagree") and 3 ("totally agree"). Figure 2 shows the arithmetic average values of respondents' responses. Both values of all statements are shown. The left bar from each number is indicating current status and right bar target status. Creative tension is therefore be found from the difference between these two bars. I.e. the left bar of the same number is shorter than the right bar, the direction of difference will give the creative tension's direction and length difference will give magnitude. Leadership styles are also separated in Fig. 2.

From the Fig. 2 it can clearly be seen that the case study leaders see that both the current state of the leadership and the target state of the leadership is strongly coaching and supporting. The leaders want to highlight that the workers are taken into consideration and they are committed to their jobs. Their professional competence is trusted and they are given responsibility for prioritizing their own duties. The only caused divergent opinions on the matter was a claim that would be superior response to help subordinate find the motivation to work. This is clearly shown in Fig. 2 in the two lower columns, no. 11.

The least supported style was directing. This quite authoritarian leadership style was hardly identified in the respondents' own leading styles and the aspiration to use this type of leadership was also further reduced. Regarding this style of the only argument that the supervisors seconded was "Leader will designate tasks and clarifies them if needed." The average for this leadership style altogether formed to be "partially disagree" i.e. arithmetic average of all respondents' all answers

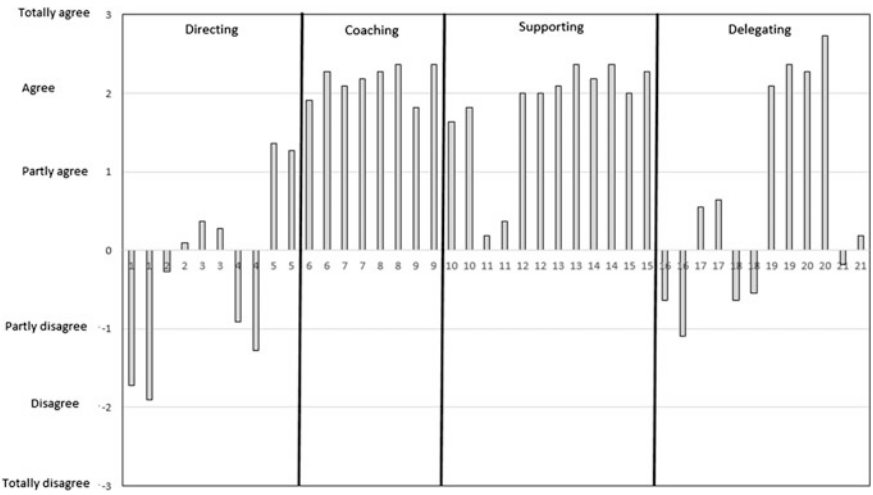


Fig. 2 Average results of case study

regarding this style was −1.18 as current and −1.55 as target status. It is also possible that the leaders do not recognize this style in their own leadership style. The results showed that the most disagreement was delegating or rewarding the work. Some of the respondents were strongly in the mood that the subordinates are able to self-prioritize their duties and some were totally against it. Interesting details are found when the same leaders disagree that followers should be supervised tightly, but at the same time they also disagree that followers could decide how to plan their jobs. The statements regarding motivating followers by rewards and punishments divided strongly. Some respondents seemed to interpret the statement to "Make a mistake and you will be punished", while the others understood "The good work can be rewarded" e.g. different bonus systems, additional free time, etc. Mistake was the integration of these two issues into one statement.

3 Conclusions

Leadership is not measured only by titles, authority or characteristics of leader. Leadership is about providing guidance and a direction for the team and the team members, empowering the culture where the team members are inspired by a common purpose, and are willing to take a significant role in succeeding. Leader should be able to handle followers individually and set the limits for freedom or tear down the barriers of self-actualized independent performance whatever the case may be. Therefore leader's need different styles for their working roles. The leadership styles discussed in this paper reveals what types of leadership styles are effective in different contexts. The main idea in situational leadership is that the leader changes his/her own leadership style according to the situation. And as the situations change, the leaders should possess various different styles in their leadership tool boxes.

The latest word has not said when combining all leadership styles together but quite thorough ontology has been built in this paper. Ontology combines over 10 well known and distinctive leadership approaches to one regarding how they handle different styles.

Paper also presents small scale case study in order to find out feasibility for study leaders' styles and their development needs via survey. Even that this case study is limited to situational leadership styles it reveals quite well that if more sophisticated survey will be done, leadership styles could be revealed from leaders' own answers.

In order to deepen understanding of leadership styles' similarities and differences possible gaps in this ontology should be fulfilled and relations between styles should be researched in holistic research where all styles are represented and the same respondents will answer to all statements. Also qualitative approach with, e.g. 360 interviews would give more information whether styles that leaders are using are appropriate from other points of view.

References

1. Reunanen, T., Valtanen, J., Windahl, R.: Evolutionary approach to modern creative engineering studies at Turku University of Applied Sciences. In: International Conference on Engineering Education, 30 July–3 August 2012, Turku, Finland 2012—Proceedings (2012)
2. Reunanen, T.: Human factor in time management. Science direct. Proc. Manuf. **3**, 709–716 (2015)
3. Reunanen, T.: Chronos and Kairos—understanding and managing time. In; Kantola, J. (ed.) Oranizational Resource Management. Theories, Methodologies and Applications. CRC Press, Boca Raton (2015)
4. Lewin, K., Lippit, R., White, R.K.: Patterns of aggressive behavior in experimentally created social climates. J. Soc. Psychol. **10**, 271–301 (1939)
5. White, J.H.R.: Successful Supervision. McGraw-Hill, London (1975)
6. Tannenbaum, R., Schmidt W.H.: How to Choose a Leadership Pattern. Harvard Business Review (1973)
7. Likert, R.: The Human Organization: Its Management and Value. McGraw-Hill, New York (1967)
8. Yukl, G.: Leadership in Organizations. Prentice-Hall International Editions (1989)
9. Yukl, G.: Effective leadership behavior: what we know and what questions need more attention. Acad. Manag. Perspect. **26**(4), 66–85 (2012)
10. Blake, R.R., Mouton, J.S.: The Managerial Grid III: The Key to Leadership Excellence. Gulf Publishing Co., Houston (1985)
11. Reddin, W.J.: Managerial Effectiveness & Style: Individual or Situational. McGraw-Hill, New York (1970)
12. Northouse, P.G.: Leadership: Theory and Practice, 5th edn. Sage, Thousand Oaks (2007)
13. Fiedler, F.E.: A Contingency Model of Leadership Effectiveness. Advances in Experimental Social Psychology, pp 149–90. Academic Press, New York (1964)
14. Fiedler, F.E.: Theory of Leadership Effectiveness. McGraw-Hill, New York (1967)
15. Hersey, P., Blanchard, K., H., Johnsson, D.E.: Management of Organizational Behaviour. Leading Human Resources. Prentice-Hall Inc., New Jersey (2001)
16. Evans, M.G.: The effect of supervisory behavior on the path-goal relationship. Organ. Behav. Hum. Perform. **5**, 277–298 (1970)
17. House, R.J.: A path-goal theory of leader effectiveness. Adm. Sci. Q. **16**, 321–339 (1971)
18. House, R.J., Mitchell, T.R.: Path-goal theory of leadership. Contemp. Bus. **3**, 81–98 (1974)
19. DuBouis, M., Hanlon, J., Koch, J., Nyatuga, B., Kerr, N.: Leadership styles of offective project managers: techniques and traits to lead high performance teams. J. Econ. Dev. Manag. IT Finance Mark. **7**, 30–46 (2015)
20. Sherony, K.M., Green, S.G.: Relationships between co-workers, leader-member exchange, and work attitudes. J. Appl. Psychol. **87**, 542–558 (2002)
21. Sias, P.: Organizational Relationships: Traditional and Emerging Perspectives on Workplace Relationships. Sage Publications, Thousand Oaks (2009)
22. Bass, B.M., Avolio, B.J.: The implications of transactional and transformation leadership for individual, team, and organizational development. Res. Organ. Change Dev. **4**, 231–72 (1990)
23. Bass, B.M.: Two decades of research and development in transformational leadership. Eur. J. Work Organ. Psychol. **8**(1), 9–32 (1999)
24. Amy, A.H.: Leaders as facilitators of individual and organizational learning. Leadersh. Organ. Dev. J. **29**(3), 212–234 (2007)
25. Amabile, T.M.: How to kill creativity. Harvard Bus. Rev. **76**(5), 76–87 (1998)
26. Mackenzie, K.D.: The LAMPE theory of organizational leadership. In: Yammarino, F.J., Dansereau, F. (eds.) Research in Multi-Level Issues: Multi-Level Issues in Social Systems, vol. 5, pp. 345–428. Elsevier, Oxford (2006)
27. Zaccaro, S.J., Rittmana, A.L.: Marks: M.A. team leadership. Leadersh. Quart. **12**, 451–483 (2001)

28. Day, D.V., Gronn, P., Salas, E.: Leadership capacity in teams. Leadersh. Quart. **15**, 857–880 (2004)
29. Kerr, S., Jermier, J.M.: Substitutes for leadership: their meaning and measurement. Organ. Behav. Hum. Perform. **22**(3), 375–403 (1978)
30. Goleman, D.: What makes a leader? Harvard Bus. Rev. **82**(1), 82–91 (2004)
31. Goleman, D.: Leadership that gets results. Harvard Bus. Rev. **78**(2), 78–90 (2000)
32. Kotter, J., Cohen, D.: The Heart of Change. Harvard Business School Press, Boston (2002)
33. Salovey, P., Mayer, J.: Emotional Intelligence. Baywood Publishing Co., Inc. (1990)
34. Kantola, J.: Organizational Resource Management: Theories, Methodologies, and Applica-tions. CRC Press, Boca Raton (2015)

Path of Creativity in Entrepreneur: Basic Concept of Creative Economy Development

Varit Intrama, Sammiti Sookbanjung, Kritchana Santawee and Phattira Teerasawad

Abstract Creativity and entrepreneurship are key success factors of creative economy driven policy. Understanding of relationship and mechanism between them will lead to economic growth rate and achievement. The objective of this study is to find the relationship between creativity and entrepreneurship, and the mechanism that lead to conceptual development of creativity-based economy. The finding of the study will contribute mechanism of creativity formulation on a man and how to change them to be entrepreneur that will make us understanding process of creative economy development in the future. The researchers have reviewed the literature on creativity, entrepreneur, entrepreneurship, entrepreneurial characteristics, and entrepreneurial factors to form the theoretical framework and relating compartment between creativity and entrepreneur. The concept of creativity, entrepreneurship, and the relationship between both concepts are discussed in the paper. From the study, there is evidence to support that creativity is the basic requirement for entrepreneur. Environment conditions are critical factors inducing individual's creativity through creativity process and practices. Along with business conditions on creativity process and practices, eventually the content would be reckoned as entrepreneurship. In summary, entrepreneur uses background knowledge, internal and external factors, to formulated creativity. Creativity is not enough to achieve business, but also experience in business is requirement.

Keywords Creativity · Entrepreneurship · Creative-based economy

V. Intrama (✉) · S. Sookbanjung · K. Santawee · P. Teerasawad
College of Social Communication Innovation, Srinakharinwirot University,
114 Sukhumvit 23, Bangkok 10110, Thailand
e-mail: v_intrama@hotmail.com

S. Sookbanjung
e-mail: sammiti@gmail.com

K. Santawee
e-mail: good0773@gmail.com

P. Teerasawad
e-mail: gwanghtc@gmail.com

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1 Introduction

Thailand's government has been pushing "Creative Economy Policy" through the small and medium enterprises (SMEs), as development policies by funding major SMEs, manufacturing firms and agricultural firms to stimulate economic growth. The fact shows that those SMEs development policies cannot achieve economic objectives. There is less than 5 % of new firms can contribute to expected economic objectives. Major cause of failure is lack of "entrepreneur" who has business concepts and specific characteristics such as creativity, opportunity obsession, and risk taking etc.

In addition, successful entrepreneur possess not only innovative paradigm, but also solid management skill, business know-how, sufficient contacts and value creation ability: ability to create values from creativity to be innovation; as a result, short of Individual's entrepreneurship causes the business unable to contribute new ideas, new knowledge, new products and services. Creativity and entrepreneurship are key success factors of creative economy driven policy. Understanding of relationship and mechanism between them will lead to economic growth rate and achievement. Although, there have been some research and practices in creativity and entrepreneurship under the assumption of the critical factors on how to create successful businesses but there are only limited studies in specific field, especially the relationship between creativity and entrepreneur.

The objective of this paper iso investigate the relationship between creativity and entrepreneurship by proposing the relational model. In this study, we have reviewed the literature on creativity, entrepreneur, entrepreneurship, entrepreneurial characteristics, and entrepreneurial factors. We will contribute mechanism of creativity formulation on a man and how to change them to be entrepreneur that will make us understanding process of creative economy development in the future.

2 What Is Creativity?

2.1 Definition of Creativity

In general, creativity is the ability to bring something new into existence [1]. Creativity are classified to be 7 contemporary approach [2], psychoanalytic, humanistic, environment, associative, factorial, cognitive-developmental and holistic.

First, psychoanalytic explains creativity as a behavioral manifestation of defense mechanism of sublimation, the unconscious process through with the individual directs his sexual or aggressive energies into culturally approach behavior, creativity as arising from conflict at young age and as representing a defense against "libidinal" energies injurious to society. Second, humanistic, shares with psychoanalytic thinking the overview, which posits man in conflict with society. But humanistic sees all defense mechanisms as preventing the individual from

becoming himself, however, depends upon a social climate free from pressures for conformity or of stern evaluation. Third, the environment, it is believed that creativity is a natural outgrowth of favorable climate. The environmentalists' emphasis is on the manipulation of the environmental variables to augment creativity product. Forth, associative regards creativity as the process of combining mutually distant associative elements of thought, the distribution of an individual is around ideas. The associative approach presumes that creativity is dependent upon an evenly balanced, or flat, associational system.

Fifth, factorial views creativity as a function of many separate intellective factors that are structure of intellect contains three dimensions, contents; information in the environment, operation; the kinds of intellectual activities by which information in process, and product; the forms that information takes after processing. Sixth, cognitive-developmental is established on psychology, subareas in perception. Theorist believes in infant lack of creativities. But them come from environment's perception then grow and formation by psychological mechanism. Ideas are develop passed society and culture to be creativity. Finally, holistic, is aptly illustrated by two main constructs of autocentricity; the stage in which feeling states of the individual and sensory qualities of stimuli in the outside environment are not differentiated from one another and allocentricity; alternate between global attention, in which the whole object is perceived receptively, and selective attention, in which separate facets of the object are in turn actively grasped.

A most useful definition of creativity is a product or response will be judged creative to the extent that it is a novel and appropriate, useful, correct, or valuable response to the task at hand, and the task is heuristic rather than algorithmic [3], comes from a recent literature on social psychology [4].

2.2 *Process of Creativity*

There are 3 key factors in process of creativity [5]. The first is *person* that means personal experiences as background, education, society, and family. This factor is the foundation of knowledge and development, people always think toward what they see and perceive. The second is *domain* that means scope of school of thought, their belief, as scientists believe in evident but artist almost in feeling. The last factor is *field*, as persons who are gatekeepers to make decision "Creativity or not?" as gurus in each discipline.

Persons have personal ideas that were processed by their experience. They will receive knowledge and information from domain that they choose to believe. They will produce works in their principles that were decided to be creativity or not by field, guru or professional person in their disciplines. If it is not creativity, person will improve their idea again and again until passing "the creativity gate". The creativity process is shown as Figs. 1 and 2.

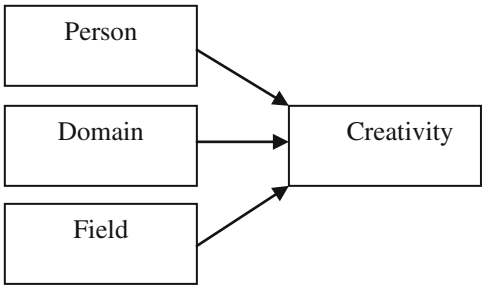


Fig. 1 Factors of creativity process

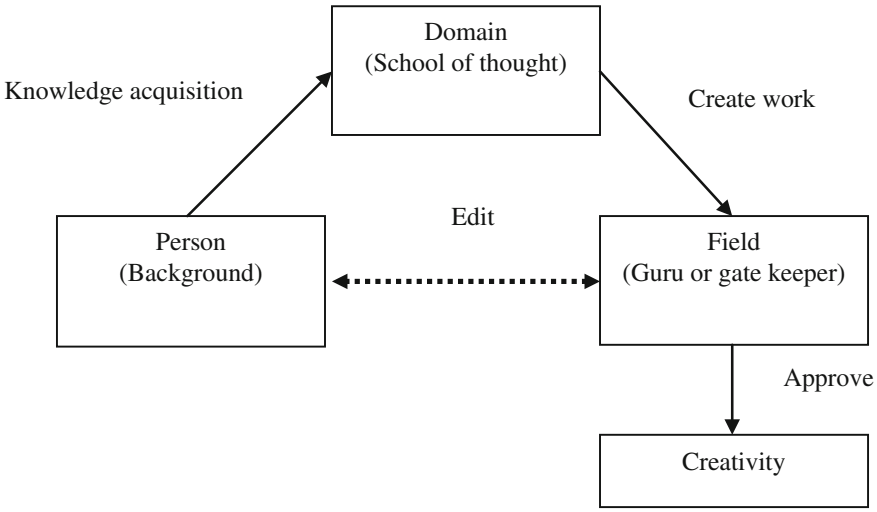


Fig. 2 Creativity process

3 What Is Entrepreneur and Entrepreneurship?

3.1 Definition of Entrepreneur

Entrepreneur is defined by many theorists, for example, the person who organizes, operates and enterprise of personal gain [6]; who reforms or revolutionizes the production by exploiting an invention. Generally, an untried technological method of producing a new commodity product or producing old one in a new way, opening a new source of supply of materials or a new outlet for products, by organizing a new industry [7]; who brings resources, labor, materials, and other assets into combinations that make their value greater than before [8]; who undertakes the creation of an enterprise or business that has the chance of profit or success [9]; who has six dominant themes of behavior, commitment and

determination are the first theme, the second is leadership, opportunity obsession, tolerance of risk, then is ambiguity, and uncertainty, other theme is creativity, self-reliance, and adaptability, and the last is motivation to excel [10]; individual who takes risks and starts something new [11]

Although the definition of entrepreneur are different according to the theories but it remains similar in their notions, for instant, managerial skill, creativity and opportunity obsession. To summarize all the definitions of entrepreneur, the following definition will be the foundation of this study: "Entrepreneurs are the persons who can find or create business opportunities and organizes the resources for their successes".

3.2 Definition of Entrepreneurship

Entrepreneurship is identified into 6 domains which are under the school of thought, the great school, the managerial school, the leadership school, the entrepreneurship school and the psychological characteristics school [12]. A large number of researches is constructed on the psychological characteristics school that believes in the individuals, psychological factors and characteristics [13]. The school also believes in the association between psychological factors and characteristics that present in the term of behavior. The literature shows various entrepreneurial characteristics, which can be concluded into 6 types which are need for achievement, locus of control, propensity to take risk, tolerance of ambiguity, self-confidence, and innovation to separate those who have entrepreneurial characteristics [14]. By the way, to becoming an entrepreneur and acting as an entrepreneur are both aspect of the entrepreneur's learning process and it was impacted by many factors [15].

Study of Gorman and Hanlon [16] they show education programs can be positively influenced to entrepreneurial attribute. Turker and Selcuk [17] propose the effective increasing entrepreneurial intention of university student that have 3 factors: additionally, educational support, structural support, and relational support. There are significant effects of university environment on student's interest in business founding [18].

Entrepreneurial characteristic is influenced by many factors but there are 3 classical factors. The first is personality [19], need for achievement, risk taking propensity, internal locus of control, or innovativeness. The second factors are the attitude approach; personal attitude toward outcomes of behavior [20], perceived social norm, and perceived behavioral control [21]. The third is external factors; a person social network [22], the image of entrepreneur in [23], social culture norm and barriers to entrepreneurship [24]. In another study, the result shows the relationship between university environment and entrepreneur intent [25]. In study of Gorman and Hanlon, they show that the education programs can be positively influenced to entrepreneurial attribute [26]. Turker and Selcuk propose the effective increasing entrepreneurial intention of university student that have 3 factors:

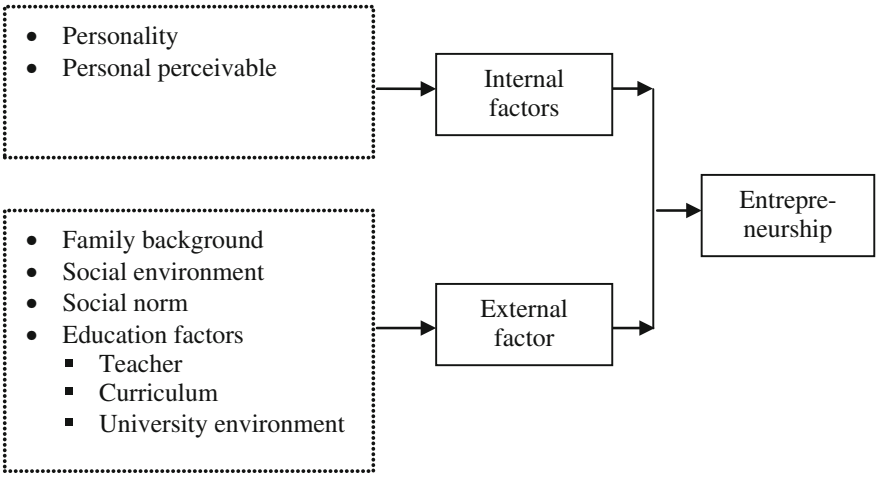


Fig. 3 Entrepreneurial factors

educational support, structural support, and relational support that are significant effects of university environment on student's interest in business founding [27].

From the reviews, entrepreneurial factors are separated into 2 types show as Fig. 3. Firstly, internal factors which inclusive of personality and personal perceivable. Secondly, external factors which are social factors-family background, social environment, social norm, and education factors-teacher, curriculum, and university environment.

The partial inconsistency of the finding of previous studies indicates that there are gaps that can be improve to better understand entrepreneurial characteristics that can create high economic values. In particular, it seems to be crucial to develop interactive models with the aim of explaining mechanism of entrepreneurial factors as a driver in the future for creative economy development.

4 The Relationship between Creativity and Entrepreneurship

From the review, creativity is the important characteristic of entrepreneur. The mechanism of creative formulation is shacked by environment, external environment; supported by approach of environment and factorial, internal environment; supported by approach of psychoanalytic, and integrate environment; supported by approach of humanistic and associative, cognitive-developmental, and holistic.

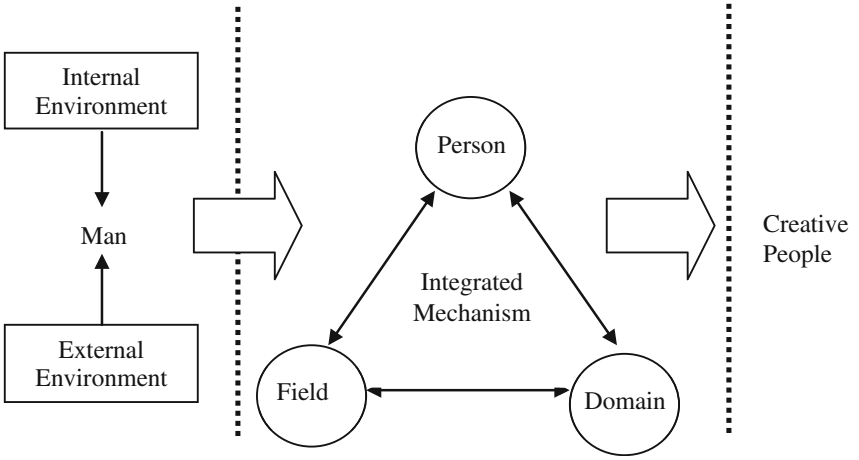


Fig. 4 Mechanism of creative people formulation

Creative people who make creativity by integrating external factors and internal factors, contribute to creativity in imaginational word. The integrated mechanism of creative person can be explained in term of creativity, person; genetic pool and personal experiences, field; social system, and domain; culture [28]. A man who grow up in social system that is a result of culture, stays with their physical and biological properties. It is the most important mode of perception. Modes are personally stimulated by internal and external environment that will set personal mind and form to be creative people. In this paper, internal and external environment are personal stimuli (Fig. 4).

Therefore, creative people are incubated by business environment who pass the mode of perception and come to be entrepreneur. Perception of business concept is affected by business environment condition, personality and personal perceivable as internal factors, and social and educational factors as external factors [29].

Afterward, norm of creative person will change to the real world and show in psychological outcome as psychological characteristics, need of achievement, locus of control, propensity to take risk, tolerance of ambiguity, and self-confidence [30]. Finally, creative person becomes entrepreneur and expresses results on psychological approach as Fig. 5.

The mixing of 2 mechanism; creative people, and entrepreneur formulation, show the relationship between them as in Fig. 6. Personal stimuli, internal and external environment, effect to a man pass person, field, and domain. Furthermore, creativity forms in individual person, but it almost just creativity not practical in the real situation. The business environment condition in form of entrepreneurship stimuli will help set the real it up in the world.

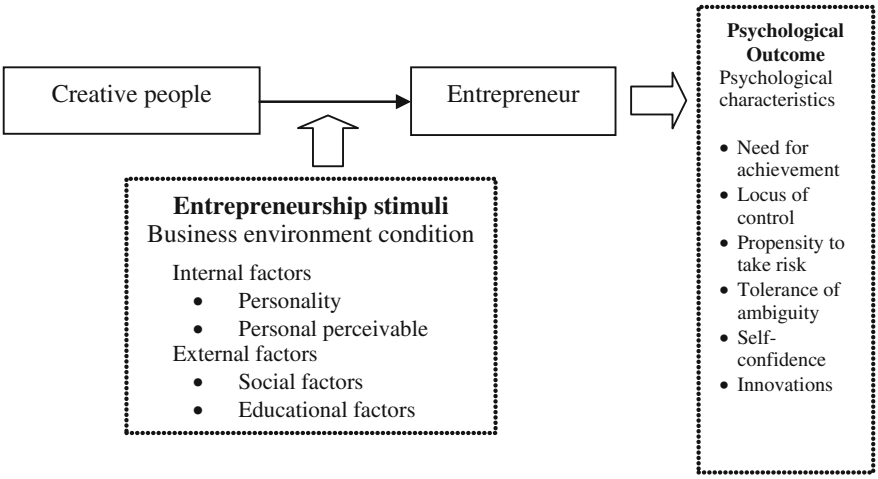


Fig. 5 Mechanism of entrepreneur formulation

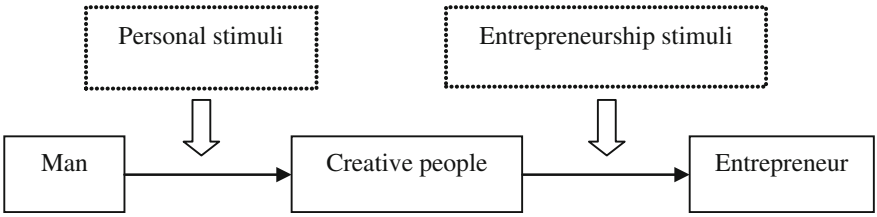


Fig. 6 Relationship between creative people and entrepreneur

5 Conclusion

Creativity is one of the most important properties of entrepreneur. Entrepreneur uses background knowledge, internal and external factors, to formulated creativity. Not only creativity is not enough to achieve business, but also experience in business is requirement. Not all of creativity will turn into real business. They are filtrated by business environment, macro environment, micro environment, and internal factor as principle of strategic management [31]. After environmental filtration, permeate as creativity is developed by new product development process. Business concept is clarified and created through business plan, marketing, operation, and finance. Details in each plan and step will establish and contribute to practical plan [32, 33]. Finally, creativity transforms to innovation, commercial invention, key success factor in current business.

The chapter presents theoretical framework and relating compartment between creativity and entrepreneur. It focuses on mechanism of creativity formulation and entrepreneur formulation. There is evidence to support that creativity is the basic

requirement for entrepreneur. Then business environment induces characteristic of creative people to be entrepreneur, comes from the imagination world to the real world.

References

1. Webster's Third New International Dictionary (1976)
2. Bloomberg, M.: Creativity; Theory and Research. College & University Press, New Haven (1973)
3. Amabile, T.: The Social Psychology of Creativity. Springer, New York (1983)
4. Kao, J.J.: Managing Creativity. Prentice-Hall International, London (1991)
5. Csikszentmihalyi, M.: Finding Flow: The Psychology of Engagement with Everyday Life. Basic Books (1998)
6. Ely, R.T., Hess, R.H.: Outlines of Economics, 6th edn, p. 488. Macmillan, New York (1937)
7. Schumpeter, J.: Can Capitalism Survive?, p. 72. Harper & Row, New York (1952)
8. Vesper, K.: New Venture Strategies, p. 2. Prentice Hall, New Jersey (1980)
9. Kuemmerly, W.: The Entrepreneur's path to global expansion. Sloan Manag. Rev. 42–49 (2005)
10. Timmons, J.A., Spinelli, S.: New Venture Creation; Entrepreneurship for the 21 Century, pp. 3–13. McGraw-Hill/Irwin, Singapore (2007)
11. Hisrich, R.D., Peters. M.P., Shepherd., D.A.: Entrepreneurship, 7th edn, pp. 6–9. McGraw-Hill/Irwin, Singapore (2008)
12. Cunningham, J.B., Lischeron, J.: Defining entrepreneur. J. Small Bus. Manage. **29**(2), 45–61 (1991)
13. Lachman, R.: Toward measurement of entrepreneurial tendencies. Manag. Int. Rev. **20**(3), 108–116 (1980)
14. Koh, H.C.: Testing hypotheses of entrepreneurial characteristics; a study of Hong Kong MBA students. J. Manag. Psychol. **11**(3), 12–25 (1996)
15. Littunen, H.: Entrepreneurship and the characteristic of the entrepreneurial personality. Int. J. Entrepreneurial Behav. Res. **6**(6), 295–309 (2000)
16. Gorman, G., Hanlon, D.: Some research perspectives on entrepreneurship education, enterprise education and education for small business management: a ten-year literature review. Int. Small Bus. J. **15**(3), 56–78 (1997)
17. Turker, D., Selcuk, S.S.: Which factors affect entrepreneurial intention of university students? J. Eur. Indus. Training **33**(2), 142–159 (2008)
18. Schwarz, E.J., Wdowiak, M.A., Almer-Jarz, D.A., Breitenecker, R.J.: The Effects of Attitudes and Perceived Environment Conditions on Students' Entrepreneurial Intent (2009)
19. Brockhaus, R.H., Horwitz, P.S.: The psychology of the entrepreneur. In: Sexton, D.L., Smilor, R.E. (eds.) The Art and Science of Entrepreneurship, MA, pp. 25–48 (1996)
20. Douglas, E.J.: Entrepreneurship as a Career Choice: Attitudes, Entrepreneurial Intentions and Utility Maximization. Frontiers of Entrepreneurship Research, Babson College, Wellesley (1999)
21. Robinson, P.B., Stimpson, D.V., Huefner, J.C., Hunt, H.K.: An attitude approach to the prediction of entrepreneurship. Entrepreneurship Theory Pract. Summer **15**(4), 13–30 (1991)
22. Autio, E., Keeley, R.H., Klofsten, M.: Entrepreneurial Intent Among Student: Testing and Intent Model in Asia, Scandinavia, and USA. Frontiers of Entrepreneurship Research, Babson College, Wellesley (1997)
23. Begley, T.M., Wee-Liang, T., Larasati, A.B., Rab, A., Zamora, E.: The Relationship Between Socio-cultural Dimensions and Interesting in Starting a Business—A Multi-country Study. Frontiers of Entrepreneurship Research, Babson College, Wellesley (1997)

24. Lűthje, C., Franke, N.: The 'making' of an entrepreneur. Testing a model of entrepreneurial intent among engineering students at MIT. R&D Manag. **33**(2), 135–147 (2003)
25. Frank, N., Lűthje, C.: Entrepreneurial intentions of business students: a benchmarking study. Int. J. Innov. Technol. Manag. **1**(3), 269–288 (2004)
26. Gorman, G., Hanlon, D.: Some research perspectives on entrepreneurship education, enterprise education and education for small business management: a ten-year literature review. Int. Small Bus. J. **15**(3), 56–78 (1997)
27. Turker, D., Selcuk, S.S.: Which factors affect entrepreneurial intention of university students? J. Eur. Indus. Training **33**(2), 142–159 (2008)
28. Csikszentmihalyi, M.: Finding Flow: The Psychology of Engagement with Everyday Life. Basic Books (1998)
29. Schwarz, E.J., Wdowiak, M.A., Almer-Jarz, D.A., Breitenecker, R.J.: The Effects of Attitudes and Perceived Environment Conditions on Students' Entrepreneurial Intent (2009)
30. Koh, H.C.: Testing hypotheses of entrepreneurial characteristics; a study of Hong Kong MBA students. J. Manag. Psychol. **11**(3), 12–25 (1996)
31. Thompson Jr., A.A., Strickland III, A.J.: Strategy Formulation and Implementation: Tasks of the General Manager, 3rd edn. Business Publications Inc., TX (1986)
32. Ulrich, K.T., Eppinger, S.D.: Product Design and Development, 4th edn. McGrawHill, Singapore (2008)
33. Kahn, K.B. (ed.): PAMA Handbook of New Product Development, 2nd edn. Wiley, New York (2005)

Part VI
Innovation Management and Leadership

Space for Company Democracy

Evangelos Markopoulos and Hannu Vanharanta

Abstract Space is a vital element in a system for the development of anything, as it defines the freedom needed to evolve, mature, and contribute. Lack of space is lack of freedom, which means lack of progress and development. Organizations are systems that are obliged to give space to new management and leadership initiatives. The Company Democracy Model, presented in this paper, is based on the space given to people to act in a democratic environment where ideas lead to meritocracy, valid knowledge, innovation, competitiveness, extroversion, and other benefits and ideals. Democracy, on the other hand, can be annoying to those resisting and reducing the space, freedom, and opportunity that people deserve to be judged upon. The paper presents numerous reasons why organizations fail to learn from their mistakes, and provides a democratic co-evolutionary and co-opetitive framework that can significantly contribute to organizational development, as long as a minimum of space is given to freedom of speech and communication.

Keywords Democracy · Change management · Leadership · Performance · Knowledge · Innovation · Applied philosophy

1 Introduction

In the world of management and leadership, every few years new buzzwords appear, attempting to refresh and maintain old practices, but avoid creating new ones. Many times in the past, and even today, such progress in management and

E. Markopoulos
Department of Production, School of Technology, University of Vaasa (UVA),
65101 Vaasa, Finland
e-mail: epm@empross.com

H. Vanharanta (✉)
Tampere University of Technology (TUT), Industrial Management,
Pohjoisranta 11 A, P.O. Box 300, 28101 Pori, Finland
e-mail: hannu.vanharanta@tut.fi

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leadership has resulted in great failures or zero contribution to the economy and the society by those who insist on managing and leading with old structures, constructs, and concepts, unable to see the current reality clearly.

Management gurus and consultants tend to make up new trendy words, under which they "hide" the good old recipes, driven only by immediate, fast, measurable, and quantifiable profitability for productivity- and performance-increasing targets. Changes in the business environment are so rapid, that company management either cannot understand the real business situation properly, by not being close to the real markets, or face communication obstacles due to their reluctance to handle mutual business promises, requirements, and responsibilities.

Knowledge workers are the people who make change happen and create the future. They can understand what is required and take responsibility as long as they are properly treated by company management. They also have a lot of knowledge and do not need the stick or carrot to innovate. All they need is a responsive environment in which to do their work, create ideas and insights, innovate, implement, test new products and services, and otherwise keep the business up and running. It is vital to adopt new management and leadership skills, capabilities, and competence as well as a responsive environment for handling new challenges and risks effectively in today's continuously changing business world.

2 Current Business Environment

It is amazing how rapidly many progressive management and leadership buzzwords have dramatically failed or been used against true organizational development values, attitudes, and ethics under the goals of fast and cheap organizational profit and productivity requirements. Words like 'down-sizing', 'right-sizing', 'total quality', 'win-win', 're-engineering', 're-structure', 're-ignition', 're-x..', re-y..', 're-z….', and others have been used primarily against people, who always seem redundant or in excess on organizational profit charts or cost/expense sheets.

All those 're-….' words and other similar concepts developed in the last 20 years give the impression that success is difficult to achieve; that failure dominates the outcomes of any activity and effort, and that it is wise to always have at least a second chance. Such concepts and especially one like the 're-try', 're-think' 're-design', etc. act as a shield for management and leadership insecurity, incapability, and immaturity. Every few years a new 're-'turns up to make up for continuous failure, giving a second chance and then a third chance, and so on, making all this not only look logical but also be conceived and accepted as new and successful management and leadership trends. Such trends have been adopted not only by neo-managers as a chance to learn from their mistakes, but also by old-fashioned managers as a second chance to do modern things right.

3 The Innovation Paradox

Innovation now seems to be the new neo-management victim; another misconceived pseudo-knowledge buzzword for this kind of pseudo-development that suddenly everyone is talking about. The word is spread to make us believe that organizations that innovate will survive and all others will die, or that innovative people will succeed while the others will fail. Innovation seems to be the new carrot in order for the whip to be used again on working people/employees for higher productivity, profitability, and performance rates.

Unfortunately, real innovation today, through real research and development, is approached primarily as a cost center and not as a profit center. Innovation in most corporations turns out to be a stressful race for profit and competitiveness, a tool for glamorous corporate press releases and announcements, an obligation under time pressure with imaginary deadlines that allow no time to envision, dream, and therefore think. Such approaches, adopted by those who have never innovated, but are called upon to manage innovative minds without a knowledge development culture, strategy, and real commitment, are quite likely to fail dramatically. In such cases, well-paid pseudo-gurus and neo-managers who failed due to their epidemical knowledge of critical concepts, start looking for other management 'buzzwords' to cover up or excuse failure. In management and economics, there is always a way to put the blame on geo-socio-techno-cultural-economic-politics-x-y-z unpredictable situations that unfortunately trigger failure.

The way innovation is treated and promoted so suddenly must trouble the real thinkers. For neo-managers who cannot see the wood for the trees, innovation is the buzzword of the day. Tomorrow there will be something else. After 're-invent' was introduced loudly in 2006 [1–3] and keeps on being used with an even bigger fanfare, the word 're-innovate' [4, 5] is now starting to appear in the international management communities (Re-Innovate Innovation, Re-Innovate for Success, etc.) as a shocking trend. What is invented cannot be re-invented and what is innovated cannot be re-innovated, unless they were never invented or innovated in the first place.

Unsuccessful invention and innovation initiatives and investments are reported widely, but it is not the case that innovation programs cannot be successful, but rather that they need time to bring results, and require investment in people (intellectual capital) rather than machines (financial capital). Moreover, they need strategic thinking, scenarios, visions, goals, challenges, change, management, leadership, and envisioning with patience instead of quick, cheap, and fast actions for either immediate profitability or marketing and promotion exposure.

4 Understanding Innovation

Many managers are well aware that, in order to invent and innovate, long-term investment in intellectual capital is required in an innovation culture built to host, promote, and support innovative thinking. Unfortunately this is the hard part, this is

the real work to be done, and something that is systematically avoided either as theoretical and wishful thinking or as costly initiatives [6]. What is worse is that such managers and leaders, if they can be called leaders, exist in all types of organizations and have cost-oriented thinking about innovation.

Innovation is purely a process of the people, state-of-the-art human resource management, a new meaning to managing and leading people, a new discipline for managing and leading organizations, and a new measure of total success. 'Why innovate?' can be the first question toward developing a responsive innovation culture. Achieving innovation success requires a tremendous effort toward reaching the truth.

Management and leadership should rely more on information and knowledge creation through their own people, those who can innovate but also create products and services for people, i.e., the markets, economy, and society. Innovation needs to be understood from the holistic point of view.

5 The Need for a New Responsive Innovation Culture

In current management and leadership trends, one of the most popular concepts used is innovation. Everyone talks about innovation as the success recipe for all types of organizational operations in a local, regional, territorial, or globalized environment. However, very few mention the need for developing a responsive environment for innovation creation and learning first. The same few managers and scholars support the strategic importance that innovation cultures have in the development of corporate information and knowledge. Organizational cultures and responsive cultures in particular are still treated as theoretical, costly, and time-consuming initiatives, hard to establish, adapt, accept, and communicate.

A responsive innovation culture needs a holistic concept of man, the ethos, and bravery to dare to learn first about ourselves. The ancient Hellenic Delphic maxim "Gnothi seauton: Know thyself" one of the oldest quotes about knowledge, is directed to the human soul. According to Aristotle, all men by nature desire to learn, but the question is whether they are able to learn if they are unwilling to learn about themselves first.

Innovation is nothing more than true knowledge. How can we maintain a system, i.e., a culture or an environment that is responsive to data, information, and knowledge creation for innovation? Truth and knowledge can be achieved in a culture that promotes and supports self-awareness, discipline, integrity, and honesty. Innovation is based on truth and knowledge. Organizations ignoring such values and ideals can never be innovative. They can be progressive but not innovative. Innovation culture development requires more philosophical thinking and not management practices and goals. Therefore a new responsive innovation culture is needed.

6 The Power of Knowledge

True knowledge is power, and power is freedom in contrast to ignorance, which may be seen as slavery. Those who have knowledge are really free not only to reach the truth but also to create through truth. As the circle of knowledge grows, so does the circumference of darkness around it, verifying Socrates' words "This one thing I know, that I know nothing" [7]. But to have knowledge alone is not enough. Knowledge has the nature of a tool, and like any tool, it can only be effective in the hands of the person who holds it properly and wisely. Knowledge can contribute creatively but also destructively, unless developed within ethical and not only legitimate principles. People need freedom to create what they can through their own knowledge. This freedom can be created through corporate democracy culture, where respect for the individual and freedom to express ideas and feelings can give back the most to the people and to the organization.

Today, knowledge is the most democratic source of power. A society that fears knowledge is a society that fears itself. According to George Washington, "for each country, knowledge is the strongest basis for growth and prosperity." The worst enemy of knowledge is not ignorance, but the illusion of knowledge, and imperfect knowledge, as people are trained primarily to 'believe' and not to 'know'. The power of knowledge is therefore an obvious driver.

7 People's Knowledge

There have been various methods for identifying organizational knowledge, by bringing people together for a common purpose that could lead to success. One such approach was the X and Y theory of Douglas McGregor [8]. According to McGregor, people are divided into two categories, combining two different principles. The first category includes the people that can be productive under rules, controls, and rigor, while the second category includes those who can be productive in an atmosphere of trust, confidence, and encouragement. In both cases there is some unity. On the one hand, people are united through fear, on the other hand through kindness. In both categories, people become connected with people under different practices in a binary model. In both of McGregor's categories, a person can produce knowledge, and knowledge can be turned into any type of benefit, from simple products or services to highly innovative ones. The difference in this case is the momentum and efficiency of the knowledge and its deliverables. If the production of knowledge is not through kindness, this knowledge produces primarily personal goals driven for 'me' and not for 'us'. People's production and success are highly influenced by the culture and the environment in which they work and operate. In organizations where competition rules instead of co-opetition, true innovation cannot be generated, as true knowledge does not exist.

A new, more recent approach to the generation, interpretation, and utilization of organizational knowledge through unity toward creative freedom is the business model of company democracy. The model creates a business culture based on corporate ethos and unity principles, which allows organizations to develop real innovation, competitiveness, and extroversion through real knowledge from their own people regardless of their status, rank, or creation. It is precisely people's knowledge that is required in a new responsive innovation culture.

8 The Company Democracy Model

The Company Democracy Model [9, 10] is based on the wisdom of the ancient Hellenic Delphic maxims [11], primarily on 'Gnothi seauton: Know thyself', 'Metron Ariston: Moderation is best' and 'Miden Agan: Nothing in excess'. The model is executed through a framework in which an organizational evolutionary spiral method is used for the creation and execution of knowledge-based democratic cultures. The co-evolutionary spiral method contributes to the identification and achievement of the capacity, capability, competence, and maturity needed to turn data, information, and knowledge into innovations. The spiral process, in this context, is based on the idea of the degree of democracy in organizations. The model is structured so that the method reflects the Co-Evolute methodology [12] and its application in organizational democratic performance. Both Co-Evolute and the Company Democracy Spiral Method are aimed at the creation of an organizational knowledge-based culture [13]. Both methods utilize organizational knowledge by developing a culture that can constantly contribute to the organization by transforming organizational tacit knowledge into explicit knowledge [14].

The Company Democracy Spiral Method levels form a pyramid structure. The pyramid shape has been chosen to point out the incremental progression of the levels and also to illustrate that not all who attempt this route can reach the top without real commitment, determination, and organizational capability and maturity (Fig. 1). The Company Democracy levels provide the actions to be performed to identify the degree of company democracy based on the individual and collective evolution dimensions (Fig. 2). The individual side of the pyramid can remember and see the past inaccessible part of the company democracy process, accessible today and in the future. From a collective point of view, the democratic company culture basis must be firm, the created paradigm must contain all the known information, and the democratic company culture must be understood, interpreted, and perceived by each member. Therefore, for an organization, it is important first to understand the current degree of democracy and how this degree should be improved over time, through democratically oriented changes.

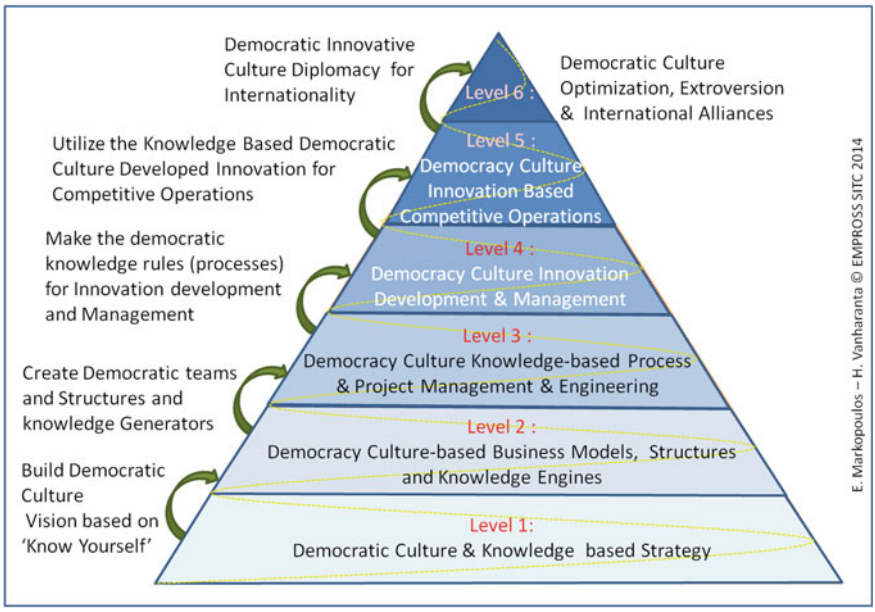


Fig. 1 The company democracy model pyramid with structured stages [9]

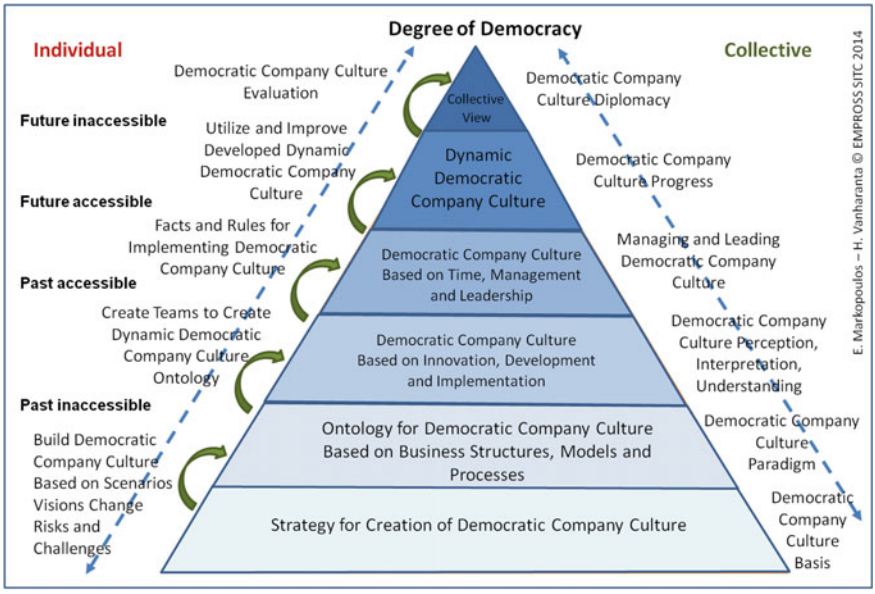


Fig. 2 Co-evolutionary individual and collective dimensions in dynamic democratic company culture development [9]

The Company Democracy Model provides a structured path to support an organization to reach democratic management and operations. As the goal is democracy for innovation, competitiveness, and extroversion, people must learn first to be co-operative in order to co-exist and co-evolve. The Company Democracy Model is both systemic and dynamic.

9 Emphasis on People

The Company Democracy Model supports an interdisciplinary approach (management strategy, knowledge, innovation, human resources, technology, production, leadership, quality, processes, leadership, engineering, research and development, etc.). It is a union of administrative and technocratic processes in an anthropocentric model that directs all practices toward uniting people through freedom of expression for knowledge generation, the actual raw material for progress and innovation. In the dynamic adaptation space of the model, the raw material for successful innovation and organizational development has no cost, as it is free within the organization and its members in particular. The main challenge is the way the organization can acquire this raw material, i.e. knowledge, from all its members without exception, and not just those selected hierarchically or the most talented. Another challenge of the space is the way this knowledge is assessed, analyzed, and re-channeled into the organization to generate further knowledge and moreover, how this knowledge will be integrated into the business operations and production in order to create innovation that can enable the organization to achieve competitive advantage and the subsequent extroversion. It must be understood that innovation has pre- and post-conditions (Fig. 3).

As a pre-condition, innovation requires the development of an ethical infrastructure than will generate knowledge, or true knowledge to be more precise. Innovation cannot be bought, imported, or copied in an organization. The post-condition of innovation is the expansion of the area of its application throughout the organization and its corporate ecosystem [15].

Innovation without a specific purpose and target will lead to re-innovation, and so on. Both types of condition require an organizational innovation culture, based on democratic principles, allowing everyone to innovate as long as the pre- and post-conditions can be defined. This will culminate in a dynamic company democracy model.

10 The Dynamic Company Democracy Space

The Company Democracy Model needs space to be conceived, evolved, and contributed to. To obtain such space, there is a need for a certain level of organizational maturity, primarily in management and leadership. People usually resist such processes in order to conceal their sense of insecurity and inadequacy. The

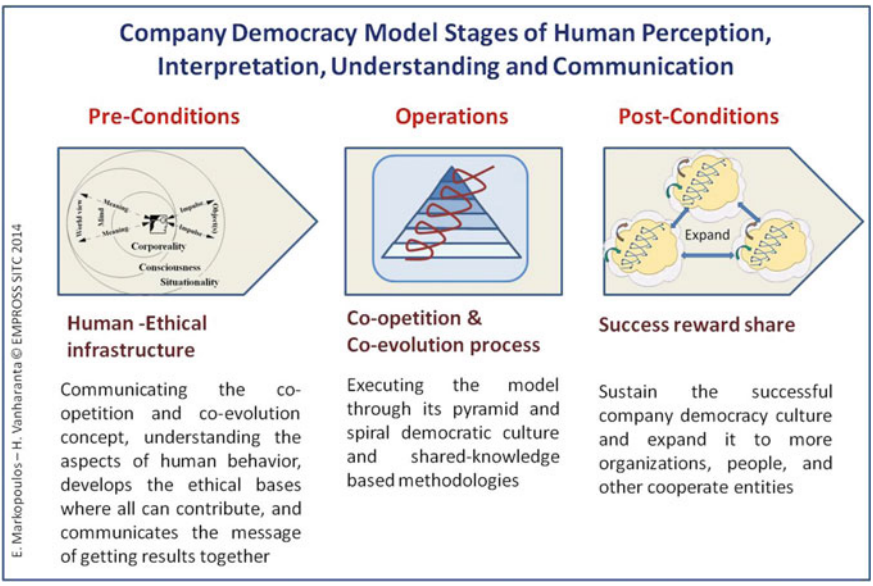


Fig. 3 Corporate democratic culture—pre- and post-conditions [15]

same people also avoid performing with the required humility needed to bring people closer in order for all to contribute their knowledge—the most important asset of any organization.

Space provides the model with the foundations to promote co-evolution and co-opetition rather than competition. Space is needed for unity rather than rivalry, for deep knowledge and not superficial knowledge, for innovation and not banality, for freedom and not slavery. People can be more innovative if they are free and together. Freedom space changes people's thinking habits, increases knowledge creation, initiates, implements, inspires, improvises, imagines, improves, ignites, invests, interacts, and incubates small things into big ideas, generates respect and enjoyment, and cultivates insight.

Within a corporate democratic space, people influence through their attitudes and values, make company democracy work for all, introducing stepwise innovation and knowledge creation processes. It is essential for an organization first to create the Dynamic Company Democracy Space (DCDS) that will allow the model to be applied effectively. The space will also allow the model to measure the current degree of company democracy, to create the democratic company culture needed, and to generate many organizational capability and maturity metrics critical to the development of a successful organizational strategy. Such metrics can reveal what is really needed by the employees, and contribute to adjusting the management and leadership styles to facilitate moving ahead with new concepts and content derived from the company democracy methodology. These and many more goals can be achieved via continuous education and learning as well as perceiving business

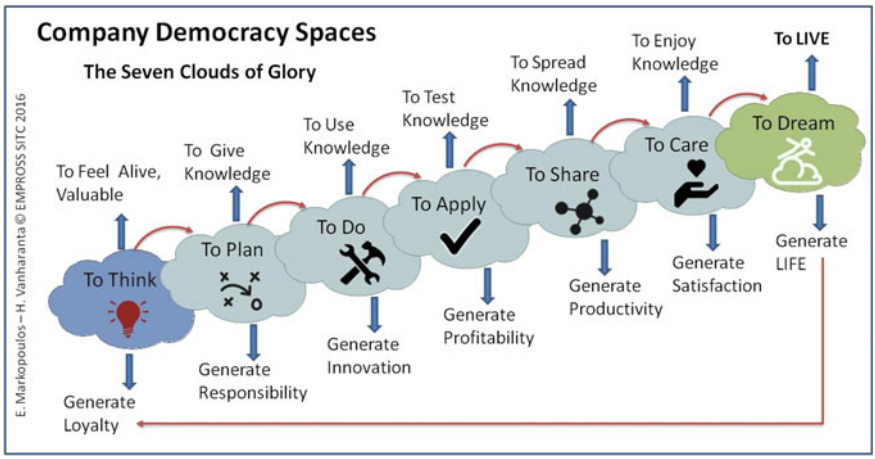


Fig. 4 Spaces in the company democracy model

processes based on a continuous strategy. Respect for working people at all levels is the basis for this new way of developing company performance. Their latent potential will be utilized as well as their productivity to get the most out of company performance. Thus, the created space is constantly dynamic. The Company Democracy model enables new dynamic business dimensions and operations to be attained by utilizing existing resources in a simple and fair way (Fig. 4).

11 Human Capital and Shared Value Innovation

Democracy in speech and actions can be demonstrated based on the shared value produced. Creating shared value for society requires the creation of added value for the organization [16].

The company democracy model, once conceived properly and given the space to evolve, can significantly contribute to the development of human capital to generate the added value that can be turned into shared value for the people, organizations, and society. Human capitalism can only be successful if it can generate added value to those who have such capital. People and organizations must utilize human capital by creating added value that proves its value capital and capitalism [17]. The company democracy model generates human capital by empowering people to utilize their potential, willpower, skills, and capability in active forms. However, skillful and charismatic people developed through democratic environments do not necessarily assure the creation of added value from their intellectual capital, unless this added value is generated in a controlled way concurrently with the development of intellectual capital.

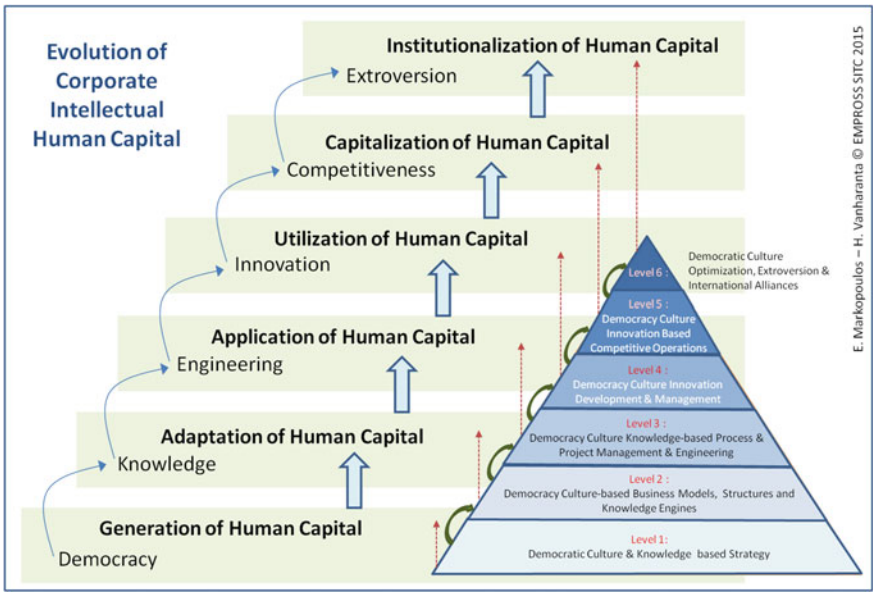


Fig. 5 Evolution of human capitalism in corporate democratic environments

Shared value in business, in turn, covers the economic value creation inside a company as well as creating value for society [18]. The target is to achieve economic success through company activities so that all the stakeholders receive their share. In this way, shared value can be seen as a creative means for meeting social requirements as well as a tool to develop company democracy. Innovation is a core element in the shared value generation process if it is derived from the intellectual human capital grown in democratic progressive, responsive, and meritocratic company environments (Fig. 5).

Democracy can generate knowledge-based innovation, and not just innovation. The transformation of people's knowledge into innovation through democratic processes aligns corporate targets with real needs, which are usually the needs of both the economy and society.

12 Discussion and Conclusions

Innovation is one of the terms widely used this decade, but it is not certain if all those who take the lead in defining innovation, especially quantitatively, consider the investments needed for organization culture issues. Innovation needs democratic organization cultures to give everyone the opportunity to deliver their share of ideas, vision, and wisdom. It is not the smartest who can innovate, but those who have knowledge and the character to share it with others. Innovation is a philosophy

and not an act, a process, project, or initiative. Innovation needs freedom, democracy, and justice.

It has been said that the message of democracy is irresistible and its progress is inevitable, meaning that management and leadership will be forced to pay more attention to it [19]. Therefore today, more than ever, there is a critical need to create space for company democracy, and to let this structure be communicated, operated, controlled, and maintained for the benefit of people, organization, and society in a systemic way. It is important for companies to educate and teach the basic methods first to their people, not as a management practice but as a corporate shared value philosophy. Such an approach allows companies to really understand how the workforce has perceived, understood, and interpreted the content in relation to implementing the company democracy space in their normal business activities. Organizations fail, not because they cannot solve their problems, but because they cannot identify them, wasting tremendous effort on trying to solve the wrong problem with the best practice. One way out of this bottomless crisis, as it seems to be, could be for organizations to emphasize the importance of identifying the skills, capabilities, competence, and maturity expected from both workforce and management/leadership. The company democracy concept can contribute to the generation of business knowledge that can be utilized in achieving added value in the markets and shared value in society. The overall thinking in this paper is based on an applied philosophy for management and leadership via the development of the appropriate responsive dynamic space in which democracy cultures can have room to breathe, grow, evolve, and give back to organizations, economy, society and people.

References

1. Merriam-Webster Dictionary, http://www.merriam-webster.com/dictionary/reinvent
2. Bertoni, M., Duncan, D., Waldeck, A.: Knowing when to reinvent. Harvard Business Review (2015)
3. Linkner, J.: The Road to Reinvention: How to Disrupt Your Organization Before the Competition Does. Jossey-Bass Publications (2014)
4. Koulopoulos, T.: The Innovation Zone: How Great Companies Re-Innovate for Amazing Success. Davis-Black Publishing, Mountain View CA (2009)
5. Cheng, C.J., Shiou, E.C.C.: Re-innovation: the construct, measurement, and validation. Technovation **28**(10), 658–666 (2008)
6. Young, S.M., Shields, M.: Managing innovation costs: a study of cost conscious behavior among R&D professionals. J. Manag. Account. Res. 175–196 (1994)
7. Stokes, M.C.: Apology of Socrates. Aris & Phillips, Warminster (1997)
8. McGregor, D.: The Human Side of Enterprise. McGraw-Hill, New York (1960)
9. Markopoulos, E., Vanharanta, H.: Democratic culture paradigm for organizational management and leadership strategies—the company democracy model. In: Proceedings of the 5th International Conference on Applied Human Factors and Ergonomics AHFE 2014, Kraków, Poland, 19–23 July 2014 (2014)
10. Vanharanta, H., Markopoulos, E.: Creating a dynamic democratic company culture for leadership, innovation and competitiveness. In: 3rd Hellenic-Russian Forum, September 17, Athens, Greece (2013)

11. Parke, H., Wormell, D.: The Delphic Oracle, vol. 1, p. 389. Basil Blackwell (1956)
12. Kantola, J., Vanharanta, H., Karwowski, W.: The evolute system: a co-evolutionary human resource development methodology. In: Karwowski, W. (ed.) In the International Encyclopedia of Ergonomics and Human Factors, CRC Press, Boca Raton, Florida, USA (2006)
13. Paajanen, P., Piirto, A., Kantola, J., Vanharanta, H.: FOLIUM—ontology for organizational knowledge creation. In: 10th World Multi-conference on Systemics, Cybernetics and Informatics. Orlando, Florida, USA (2006)
14. Nonaka, I., Takeuchi, H.: The Knowledge-Creating Company: How Japanese Companies Create the Dynamics of Innovation. Oxford University Press, New York (1995)
15. Markopoulos, E., Vanharanta, H.: Human perception, interpretation, understanding and communication of company democracy. In: 14th International and interdisciplinary Conference of the Research Cooperation. European Cultures in Business and Corporate Communication (EUCO14), 23–25 October 2014, Turku, Finland (2014)
16. Duncan, K. A.: Productivity analysis for strategic management. In: Guth, W. (ed.) Handbook of Business Strategy, pp. 17.1–17.25. Warren Gorham & Lamont, Inc., Boston, USA (1985)
17. Markopoulos, E., Vanharanta, H.: Company democracy model for development of shared value. In: 6th International Conference on Applied Human Factors and Ergonomics (AHFE), 26–30 July 2015, Las Vegas, USA (2015)
18. Porter, M., Kramer, M.: How to fix capitalism and unleash a new wave of growth. HBR, 61–77 (2011)
19. Slater, P., Bennis, W.: Democracy is inevitable. HBR, 167–176 (1990)

Innovativeness Through Time Management

Tero Reunanen, Riitta Windahl and Hannu Vanharanta

Abstract As an imperative resource, time and the usage of it should be analyzed and planned in a proper way to maximize the individual effectiveness, and thus make the time management as a functioning tool. Innovativeness is not any easier issue to master, but if a time personality is understood and taken account, a person's innovativeness can be effectively utilized. Innovativeness as a concept must be seen from a wider perspective, including both capability and willingness to act, resulting different kinds of target oriented activities in different stages of an innovation process. In this process, individual and group or network level can be separated and the meaning of a time personality for innovativeness can be analyzed to enhance an overall innovation performance of an organization. Research discussed in this paper was done by utilizing applications called Chronos & Kairos and Pursoid. Research results show that there are some very interesting combinations with conscious awareness of individuals towards time and innovativeness. There seems to be a lot individual variation where the amount of time in use is not necessarily correlated positively with the idea of high level of innovative capacity. Future research aspects and recommendations are also discussed in this paper.

Keywords Proactive innovativeness · Time management · HRM development

T. Reunanen (✉)
Turku University of Applied Sciences, Industrial Management and Engineering,
Sepänkatu 1, 20700 Turku, Finland
e-mail: tero.reunanen@turkuamk.fi

R. Windahl
Wiri Training Ltd, Turku, Finland
e-mail: riitta.windahl@wiri-training.fi

T. Reunanen · H. Vanharanta
Tampere University of Technology, Pori Campus, Pohjoisranta 11 A,
28100 Pori, Finland
e-mail: hannu.vanharanta@tut.fi

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1 Introduction

1.1 Time Personality and Management

"Success in knowledge economy comes to those who know themselves, their strengths, their values and how they best perform" [1]. Article handles personal skills in leadership domain and emphasizes highly self-consciousness. "Effective executives do not start with their tasks, they start with their time" points out that time is the limiting factor [2] and a unique resource that cannot be stored, is perishable, irreplaceable and has no substitute. Demand does not affect to it and it has no price or marginal utility, and in modern business environment, it is always short of supply, i.e. we are always lacking it [1, 3]. Therefore the first task in journey to become an effective expert is to learn how to manage oneself and learn to manage one's own time usage. Possibility to measure time duration, speed and numerical order with clocks [4], is not near enough to manage it or even understand it. Before understanding and managing time person should have conscious awareness of his or her time personality [5].

Time has two faces, subjective time and objective time [6]. Objective, or chronological time is time where business and management is done, and subjective time is where leadership and human actions are made [5] Cf. for Czarniawska [7] for history of Chronos (chronological) and Kairos (human time) two ancient Greeks gods for time. As chronological, objective, time is easy to synchronize with clocks, subjective time is relativistic and the speed of it is dependent of many factors. Personal way to utilize and sequence time, feeling [6], cultural background [8], situation, time pressure [9], sleep deprivation [9, 10], personal traits [11] and planning personality [12] are all issues which bias experienced time from objective time [5].

Most of us have experienced a lost tracking of time i.e. feeling of timelessness [13], when time flies. Extreme case of this is called to flow a phenomenon of complete focus and motivation [13]. On the other hand, everybody has experienced feelings when doing something unpleasant or boring, time nearly stops. Satisfying situation makes feeling towards time positive [6]. Hectic situation may cause willingness to compress every moment of the day with very intensive activities and try to get to the essence of things. If this continues too long, balance of life will suffer [3]. Compressive mindset might end up to "implying that rational reduction of information, emotions and alternatives is necessary to reach organizational and individual goals." and leads to a situation where quality, creativity, open-mindedness, innovativeness and empathy are reduced [14]. This compression of time is heavily against Drucker's [2] suggestion, where people "have to feel that we have all the time in the world". Studies show that if balance s not found between personal life and work, organization may start to lose their workers as that balance has been found to be the most or the second most important attribute of the job [15]. Possibility for self-development is also a factor what makes time as positive thing [6]. It's also found that when a person does not receive enough time for rest and sleep, it may lower his or her self-control and unethical behavior will be more probable [10].

Sleep-deprivation seems to harm time-pressured activities [9]. Personal traits are also key issues in biased time personality [5]. These traits are perfectionist, preemptive, people pleaser and procrastinator [11] and especially if added with insufficient delegating skills [16] and too optimistic future orientation [12], whereas tendency for long term vision reduces biases when compared to short term visioning [6].

Before mastering concept or managing time, it must be recognized that time cannot be either accepted or denied; own systematic ways should be found to become aware of one's own time and its use, own thoughts and ideas of time expressed and comparisons and analyzes of one's own thinking regarding time should be done with other methods and thinking processes [17] i.e. consolidating it to bigger sections [1] and parts of own life. Time usage on the other hand cannot be mastered if boss, system, peers, or followers use all time available [16]. Time usage is also divided by locations or work style [18], by with whom time is spent [3, 19] or how big portions work is done [20]. Despite of division system it still should be kept in mind that time is a limiting factor in all activity—not tasks themselves.

1.2 Innovativeness

"Innovation" in its wider and general meaning can be defined as the processes where new ideas are implemented within an organization. Thus, innovation is an establishment of new concepts, procedures or technologies in an organization. By nature, innovation processes are commonly non-linear and require accordingly flexible and adaptive tools. In an innovative evolutionary process, it is a question about changing ideas into technological, social, and institutional assumptions that blend in with normal practice, processes or products [21]. Much concern has been expressed about physical infrastructure related to research and development (R&D) activities at organizations, as if there was some positive correlation between physical resources allocated to R&D activities and a successful outcome as a result. Though, more and more attention has recently been paid to other factors, so called innovation drivers that might function as an innovative stimulant for any R&D system. In this system the mental facilities are also taken account as at least as essential elements as the physical ones. For example, a right kind of state of mind together with positive attitude towards innovativeness and personal time management skills can be such essential elements [22].

Nonaka and Konno talk about "ba" as a shared space or platform where different elements of innovative activity—physical, mental, virtual or any combination of them—can be refined for an innovative outcome [23]. From the innovation management point of view, both the composition and coordination of such platforms constitute a critical framework for any innovative project. Thus, resource allocation or attention to physical infrastructure alone does not guarantee the positive outcome sought after.

At least part of all innovative activities is innovating human systems and the mental models, paying attention, for example, to human beings as the very basic building material of any organization. Such mental models should be built by using a bottom-up philosophy, according to which an organization culture and a management philosophy permit and encourage idea generation among employees, as well as freedom to bring some experiments into effect without a fear [24]. Though, a top-down philosophy is also needed to steer and control the whole system in a goal oriented manner. Plain bottom-up philosophy might lead to pure anarchy and uncontrollable chaos in the innovative process, while plain top-down philosophy might suppress innovativeness and restrain motivation in general. In most creative activities it is mainly question about creating favorable circumstances in general, and for a situation at hand in specific [22].

Latour approaches the innovativeness and innovative networks especially from the artifact's perspective and questions the relevance of dividing the elements into human and non-human items [25]. In his Actor-Network Theory (ANT) he equalizes all the elements, players and systems within any innovative network, and takes account all the items as critical ones which can ruin or save the result or outcome, making no division into human or other-than-human factors. However, the consciousness of these different elements or factors related to both physical and mental facilities in any innovative activity might help a lot to tackle the possible setbacks looming while some innovative solutions are needed.

It is obvious that in any innovative activity some human systems and mental models are more or less involved, and ignoring these systems and models can cause a failure. Thus a lot of attention must be paid to the structure and functioning of management strategy and organization culture in general, and innovation management in special to steer and manage these innovative activities.

2 Research Setting

The main approach and mind set for this study is Evolute approach by, applying ontology engineering, precisiation of meaning, and usage of soft-computing methods and fuzzy logic in order to found out what is and how to cope with uncertainty and imprecision in human knowledge inputs [26]. The aim of the research was to find out what kinds of similarities there are between person's time personality and innovativeness. Research was executed by utilizing applications called Chronos & Kairos [27] and Pursoid [28]. The main purpose of Chronos & Kairos application is to reveal individual conscious awareness of time and to give a possibility for analyzing differences in individual time experiences, whereas Pursoid is developed for analyzing conscious awareness concerning individual innovation capabilities and competences. Both application statements are formed so that they will give a comparable picture regarding respondent's current situation,

target situation and creative tension, i.e. proactive vision of different features and competences. Respondents answered for statements so that they chose level from analogy answering scale from two points of views, current situation and target situation, expected future level. Scales for answers were e.g. never, sometimes, usually and always but there were no steps, such as in Likert scale, so the selection is done analogically and freely.

Chronos & Kairos is constructed so that it includes different (n = 24) features and categories (n = 9) under these six main points. These categories are divided under two main classifications: (1) managing time and (2) experiencing time. Features of the Chronos & Kairos can be seen in Fig. 1. Pursoid consists (n = 36) individual features called competences, which are grouped to different (n = 9) sub-groups and two main groups: (1) personal competences and (2) social competences. Competences are illustrated in Fig. 2.

All answers for statements were handled as decimal number variables valued between 0 and 1. Respondent's linguistic answers were formed to numbers by fuzzy logic. Fuzzy logic is used in order to process linguistic data in computational, numerical ways. Fuzzy sets are ways to represent vagueness in linguistics [29]. These systems possess powerful reasoning capabilities. Fuzzy logic is used in the application to handle the imprecise information which is the nature of information in the human decision-making processes. There is also natural fuzziness in the evaluation processes of individuals [30]. Fuzzy logic controllers usually consist of four modules: fuzzification, interface, rulebase and defuzzification [31].

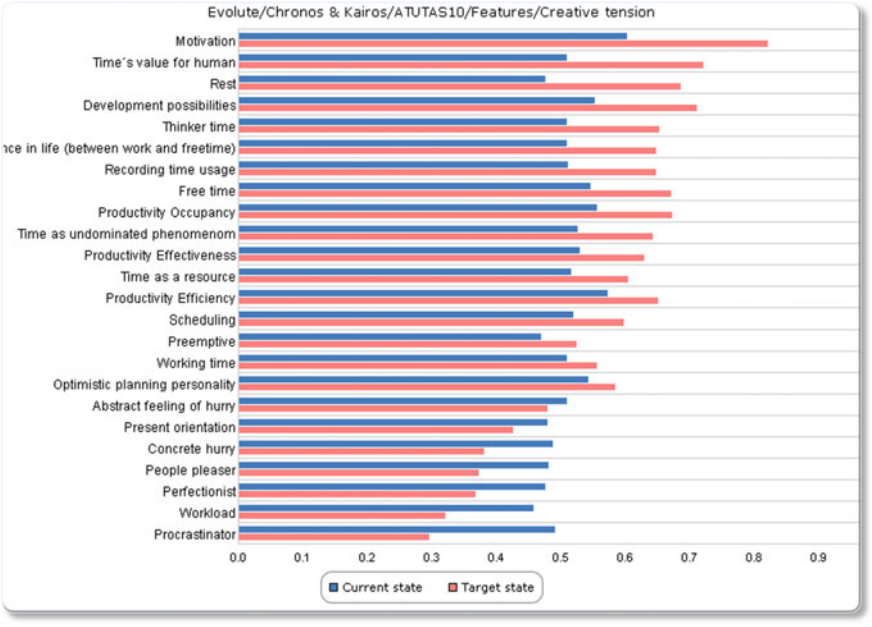


Fig. 1 Results of creative tension from Chronos & Kairos

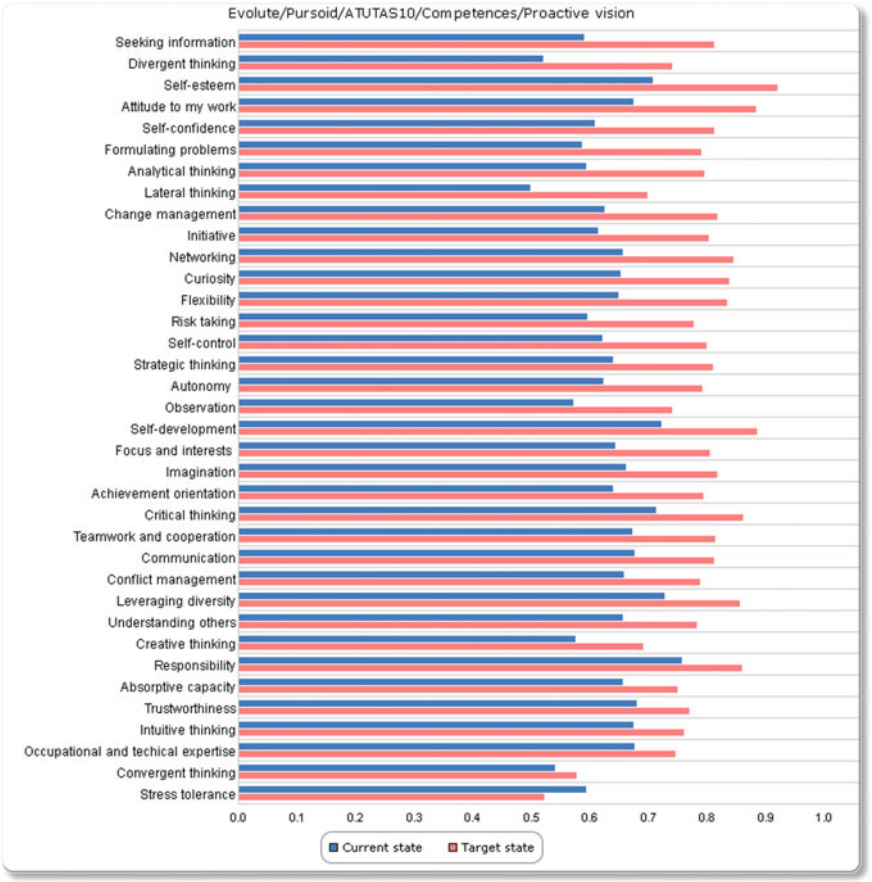


Fig. 2 Results of proactive vision from Pursoid

2.1 Data in the Research

Research data collection was executed in 2014–2015 and consisted of 135 individual respondents answering both research applications. Respondents were students from Turku University of Applied Sciences. Students were mostly from engineering and business degree programmes and represented full time students and part time (working adult) students. Age variety was 18–55 and arithmetic average settled to 25.6 years when 2 of respondents didn't want to reveal their ages. Both genders were presented quite equally. From 135 respondents 31 answered female and 37 answered male and 67 left this question blank. Respondents' work experience varied from 0 years (19 persons) to over 20 years (10 persons) and average was 5.2 years. One respondent left this question unanswered. Respondents' nationality was mostly Finnish. From 135 respondents there were Czech, French,

German and South Korean one per each, Austrian, Chinese, Spanish two from each, 3 remained unclear and rest were Finns.

Respondents answered to 167 statements in Chronos & Kairos in a way to reveal their present feeling (current status) and future target feeling (status) to each given statement, and 173 statements in Pursoid with similar current and target status point of view. Research was made by utilizing Co-Evolute research tool Evolute. Every respondent's every answer for every statement in both applications was integrated to every other respondents answers in three different cases: current status, target status and creative tension i.e. proactive vision. Creative tension is difference between target status and current status and therefore points out respondent's magnitude and direction for development need. Creative tension was calculated by subtracting current status variable from target status variable. Research data was consisting of 135 respondents' 168 answers in Chronos & Kairos application and 173 answers in Pursoid application and all statements were answered twice, once for current and once for target status. All together research data mass consisted 92 070 variables as shown in Eq. 1 below here, where x is number of variables and n is number of respondents.

$$x = 2n(168 + 173) \tag{1}$$

2.2 *Results from Study*

Figure 1 is illustrating research results from time personality and management application Chronos & Kairos and Fig. 2 is showing results from Pursoid application which reveals innovation competences and capabilities. As seen from the figures, both applications have similar way to represent results of research. These figures are showing features' and competences' relative order to each other considering creative tension i.e. proactive vision i.e. difference between target status and current status. Therefore from Figs. 1 and 2 it is possible to see which respondents' main developing needs are. Features and competences are arranged so that in the top of the figure there are issues which should be added most and in the bottom of the figure there are issues which should be lessened most. Figures also show how far from the neutral axis respondents see that they are. This is indicated in the bottom of the figures by showing the decimal number between 0 and 1.

It could also be seen from the figures NN and NM that in Chronos & Kairos there are features which could be understood to be more negative than positive and these features are, most cases, needed to be lessened. On the other hand, in Pursoid all competences are positive and hence are something to be strengthened. This could be seen when comparing direction of creative tension and proactive vision from the figures.

As seen from Fig. 1, respondents feel that their top 5 development needs in understanding and managing time are: (1) Motivation, (2) Time's value for human, (3) Rest, (4) Development possibilities and (5) Thinker time. These five features

respondents feel that they should add most. When taking into consideration that sixth feature in this list is balance in life (between work and free time) it creates to our mind picture of people that are in a hurry, and somehow overwhelmed in their tasks. Quite large gap between current status and target status in motivation, rest and balance are indicating stressful situation and need for understanding for time's value supported with need for more thinker time (own peaceful time for thinking) are indicating that respondents are also understanding what is missing. Hunger for development possibilities is also quite understandable for students. They feel that they want to learn how to cope with these situations better.

When looking the most needed features to lessen we found (1) procrastinator, (2) workload, (3) perfectionist, (4) people pleaser and (5) concrete hurry from the Fig. 1. These indicate quite well that respondents are looking for at reasons for this situation from themselves and actual amount of work. Procrastinator, perfectionist and people pleaser are all traits that cause quite much problems in personal time management [5, 11]. Workload and concrete hurry are indicating that respondents really feel that they have to lessen their workload and hurry. As abstract feeling of hurry is not as needed to lessen, it shows that respondents know where this hurry comes from.

On the other hand when scrutinizing results by looking which features are highest or lowest in current level we find that top five is: (1) Motivation, (2) productivity efficiency, (3) productivity occupancy (4) development possibilities and (5) free time. This indicates that respondents are motivated, even that they want more motivation, and they have development possibilities, they feel that they are efficient and are able to work in reasonable batches and they have enough free time. When looking last five features from the current situation we find (1) workload, (2) preemptive, (3) rest (4) perfectionist and (5) present orientation. This means that respondents are mostly coping with their workload—though they want to lessen it, they don't have enough rest and they are feeling bit too preemptive or perfectionist.

The top five innovation competences which are seen to be strengthened by respondents are: (1) seeking information, (2) divergent thinking, (3) self-esteem, (4) attitude to my work, and (5) self-confidence.

The least needed top five competences are: (1) stress tolerance, (2) convergent thinking, (3) occupational and technical expertise, (4) intuitive thinking and (5) trustworthiness. In these areas of innovative competence the respondents ranked themselves quite equal with the requirements set for them at their future work.

When looking at the top five competences from current status from innovation competences, they are (1) responsibility, (2) leveraging diversity, (3) self-development, (4) critical thinking and (5) self-esteem. It can be seen that respondents felt somewhat strong in these areas, but on the other hand, self-esteem and self-development were also seen among biggest personal development areas, telling apparently their importance for respondents. Lateral thinking, divergent thinking, convergent thinking, observation and creative thinking were respectively weakest competences of respondents. This might at least partly indicate the status of respondents—as students they probably do not have so much idea or experience of different kinds of thinking and observation skills needed in their future work.

Table 1 Comparison between proactive vision

	Chronos & Kairos/Time management	Pursoid/Innovation Competences
Top 5 in both	Motivation	Seeking information
Top 5 in both	Time's value for human	Divergent thinking
Top 5 in both	Rest	Self-Esteem
Top 5 in both	Development possibilities	Attitude my work
Top 5 in both	Thinker time	Self-Confidence
Last 5/Top 10	Concrete hurry	Formulating problems
Last 5/Top 10	People pleasing	Analytical thinking
Last 5/Top 10	Perfectionism	Lateral thinking
Last 5/Top 10	Workload	Change management
Last 5/Top 10	Procrastinating	Initiative

2.3 Comparison of Results

Since there is difference between applications regarding issues in these two research sets, there are no negative competences which should be lessened according to that data alone. Comparison is made so that Table 1 consists of five features which should be most enhanced and five features which should be most lessened from Chronos & Kairos and ten competences which need most development from Pursoid.

When looking intuitively comparison between time management's and innovation competences' proactive vision it can be seen that hurry and workload have connection to innovation competences development also. Information seeking development need may be probably highlighted also because respondents were students.

Table 1 is set just for demonstration purposes only. Direct comparison should not be made between features and competences.

3 Conclusions

Time and innovation management are not easy to master. Both are situational and both need intentional development and continuous work in order to advance towards mastery.

It seems that there is a lot of correlation between time and innovation management. E.g. decisions are moving from long term to short term in hurry, thinking time is lessened and personal trait are moving to front.

In order to find out what features and competences correlate to each other or are in some relation with each other, further analysis and future research should be done with statistical analysis. Main questions which rose during this research were: Which statements are correlating between Chronos & Kairos and Pursoid

applications? Do the respondents who possess similar time personality possess similar innovation competences also? What are the main characters of these?

From the innovation management point of view it is important to know your team and their competences, as well as the way the individuals self see their skills and their possibilities for development. With right kind of tools and encouragement these individual processes can better be managed and steered.

References

1. Drucker, P. F.: Managing oneself. Harvard Business Review (2005)
2. Drucker, P.F.: The Effective Executive. Harper & Row, New York (1967)
3. Turnbull, S.: Perceptions and experience of time-space compression and acceleration. J. Manag. Psychol. **19**(8), 809–824 (2004)
4. Sorli, A.: Time as a stream of change. J. Theoret. **4–6** (2002)
5. Reunanen, T.: Human factor in time management. Procedia Manuf. **3**, 709–716 (2015)
6. Harung, H.S.: Reflections. Improved time management through human development: achieving most with least expenditure of time. J. Manag. Psychol. **13**(5/6), 406–428 (1998)
7. Czarniawska, B.: On time, space and actions nets. Organization **11**, 773—791 (2004)
8. Lewis, R.: When Cultures Collide. 3rd edn. WS Bookwell, Finland (2010)
9. Kobbeltvedt, T., Brun, W., Laberg, J.C.: Cognitive processes in planning and judgements under sleep deprivation and time pressure. Organ. Behav. Hum. Decis. Process. **98**, 1–14 (2005)
10. Barnes, C.M., Schaubroek, J., Huth, M., Ghumman, S.: Lack of sleep and unethical conduct. Organ. Behav. Hum. Decis. Process. **115**, 169–180 (2011)
11. Berglas, S.: Chronic Time Abuse. Harvard Business Review, pp. 90–97 (2004)
12. Buehler, R., Griffin, D. Planning, personality, and prediction: the role of future focus in optimistic time predictions. Organ. Behav. Hum. Decis. Process. **92**, 80–90 (2003)
13. Csikszentmihalyi, M.: Beyond Boredom and Anxiety. Jossey-Bass, San Francisco (2000)
14. Sabelis, I.: Hidden causes for unknown losses: time compression management. In: Whipp, R., Adam, B., Sabelis, I. (eds.) Making Time. Oxford University Press, Oxford (2002)
15. Johnson, J.: Flexible working: changing the manager's role. Manag. Decis. **24**(6), 721–737 (2004)
16. Oncken, W., Wass, D.L.: Management time: who's got the monkey? Harvard Business Review (1999)
17. Jönsson, B.: 10 Ajatusta ajasta. (10 Thoughts about time) Karisto Oy, Hämeenlinna (2000)
18. Oshagbemi, T.: Management development and managers' use of their time. J. Manag. Dev. **14** (8), 19–34 (1995)
19. Bandiera, O., Guiso, L., Prat, A., Sadun, R.: What do CEOs do? EUI Working paper ECO2011/06. European University Institute, Florence (2011)
20. Tengblad, S.: Time and space in managerial work. Scand. J. Manag. **18**, 543–565 (2002)
21. Valtanen, J., Windahl R., Reunanen, T.: Innovation policy explored using evolutionary concepts—case finnish maritime industry. In: Conference Proceedings, ICEER (2013)
22. Reunanen, T., Valtanen, J., Windahl, R.: Evolutionary approach to product development projects. In: Conference Proceedings, Izmir (2013)
23. Nonaka, I., Konno, N.: The concept, of "ba"; building a foundation for knowledge creation. Calif. Manag. Rev. **40**(3), 40–54 (1998)
24. Bhardwaj, G.: Changing mental models to make innovations work. Innov. Manag. **2**, 64–65 (2011)

25. Latour, B.: The social study of information and communication study. In: Avgerou, C., Ciborra, C., Land, F. (ed.) Oxford University Press, Oxford, pp. 62–76 (2004)
26. Kantola, J.: Organizational Resource Management: Theories, Methodologies, and Applications. CRC Press, Boca Raton (2015)
27. Reunanen, T.: Chronos and Kairos—understanding and managing time. In: Kantola, J. (ed.) Organizational Resource Management. Theories, Methodologies and Applications. CRC Press, Boca Raton (2015)
28. Vanharanta, H.: Pursoid: innovation competence of human resources. In: Kantola, J.: Organizational Resource Management: Theories, Methodologies, and Applica-tions. CRC Press, Boca Raton (2015)
29. Lin, C.T., Lee, C.S.G.: Neural fuzzy systems—a neuro-fuzzy synergism to intelligent systems. Prentice-Hall, Inc. (1996)
30. Kantola, J., Nurminen, K., Piirto, A., Vanharanta, H.: The deltoid application for competence analysis and development of control room operators. In: IASTED International Conference on Neural Networks and Computational Intelligence, Grindelwald, Switzerland (2004)
31. Klir, J.G., Yuan, B.: Fuzzy Sets and Fuzzy Logic, Theory and Applications. Prentice-Hall, Inc. (1995)

Integrated Service and Product Innovation on Life Cycle Business Co-evolution

Vesa Salminen, Heikki Ruohomaa and Tapio Koivisto

Abstract The business of manufacturing companies is evolving towards knowledge-intensive industrial services. It is important to stay as near to the customer process as possible in this evolution to enable the growth of efficiency of customer business over the life cycle. In this type of business, in addition to managing material and financial flows, information and knowledge flows have to be managed much better. However, complexity is also increasing because of the new offerings and the need to network all operations and manage distributed information and competence. It is obvious that the business model and other supporting business structures of partners in the value network are in constant transition. It is thus important to master innovation in the customer process over its life cycle. The objective of this article is to introduce a concept of integrated service and product development during various types of innovation in life cycle business evolution routing. When business is changing, various types of innovations tackle it: business, market and life cycle innovation. Knowledge intensive service innovation needs open semantic infrastructure with master data structures provided by life cycle management architecture. The balance in running business comes by synergy management. The hybrid innovation model is been developed as a joint initiative between research institute experts and various international companies and was applied to individual enterprise strategies in order to validate how synergy management by hybrid innovation can be used to drive business value through creation of new services. Insight into one participant case study is provided to substantiate breadth of applicability and ease of use.

V. Salminen (✉) · H. Ruohomaa
Häme University of Applied Sciences, Hämeenlinna, Finland
e-mail: vesa.salminen@hamk.fi

H. Ruohomaa
e-mail: heikki.ruohomaa@hamk.fi

T. Koivisto
Noatek Corp., Helsinki, Finland
e-mail: tapio.koivisto@noatek.com

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Keywords Life cycle management architecture · Value model · Semantic infrastructure · Hybrid innovation · Co-evolution

1 Introduction

Manufacturing companies that are expanding their product offering to cover value-based life cycle services in the customer's facilities are facing continuous business co-evolution. By doing so, these leaders are expanding their value proposition multidimensional by concurrently creating strong potential through developing more sustainable customer-engaging products, co-innovating sustainable services together with their partners, and collaborating to create integrated new business technologies. Complexity dramatically increases when the product concept enlarges in such a way that the effect is visible but the cause is hidden. Nevertheless, not all complexity is bad; complexity can be used to aid innovation in new offerings. When making sense of it, it is essential to learn, adapt and change. Innovation and learning are not purely rational processes; they are social activities involving other people and they require reasoning, emotion, intuition and interaction. Complex systems theory provides an overall conceptual framework for thinking about the continuous innovation cycle in business co-evolution. It is important that the customer and the design team interact sufficiently to match the opportunities with customer future requirements. In industrial service innovation it is crucial that innovation opportunities run through the value network and are punctually matched according to all networked functional and customer requirements.

The competitive advantage lie in the management of the life cycle of offering structures. That means life cycle service opportunity. To fully benefit the business opportunity, modular service and product portfolio and integrated offering structure have to be managed much better than before. This requires understanding the interactions between the product, service, business process, competence elements and organizational knowledge. The product and service, distributed business processes and entire organizational knowledge have to be managed in a better way. Knowing the interactions between all these elements leads to successful management of change in a continuously evolving business environment. Architecture structures of the business, solution, process and information, and communication technology can help in this management challenge.

Häme University of Applied Sciences (HAMK) has a Smart Service-research center as dynamic breeding environment to create and execute, together with co-operation network, well-addressed research and development activities for regional and enterprise development needs. The research unit supports cross-sectorial utilization of digital technologies and service business development. The objective is also to offer development support for municipal, industrial and commercial organizations by creating new opportunities and responding on business transition challenges. The management of life cycle business in value network and entire society is becoming an important business driver. Most of companies, which

are moving towards service business, need new concepts to manage life cycle business on the responsible way. Industrial digitalization and life cycle care are key focus areas on the research strategy on Smart Service research center.

Knowledge is scattered and distributed in business networks. Competence areas have become more complicated and single human capacity cannot cope with all the needed competence to create new opportunities for businesses. Life cycle business leadership needs democratic innovation culture and co-innovation and co-evolution processes. This article introduces a concept of industrial service and life cycle business leadership. It also gives a proposal and example how to analyze co-evolution over the life cycle of business transition by using Evolute LLC, the intelligent web-based system for managing human experiences and organizational objects and capability in executing life cycle business leadership.

2 Theoretical Background

It exist quite limited amount of earlier research on life cycle business transition by integrated service and product innovation but several earlier research approaches are dealing with sub areas of this research. The theoretical background of the research approach is introduced in the following.

Kumar has introduced a concept of customer lifetime value as a metrics that would help provider enterprise to make informed business decisions [1]. Villaneuva and Hanssens have studied customer equity as measuring customer lifetime value [2]. Nonaka and Tageuchi [3] introduce that knowledge is created by flow of information and is anchored in the beliefs and commitment of its holder. Miller and Langdon [4] introduce how to manage disruptive innovation by managing platform, product and process innovation in continuous cycles. All Principles of mass customization of products and services [5] need to be applied in the adaptation of customers' needs in life cycle business. Wise and Baumgartner [6] introduce the "going downstream" theory of this transition. Skyttner [7] introduces new systems theory with self-organization and evolution. Jamshid [8] introduce that system thinking is the art of simplifying complexity. It is about seeing through chaos, managing interdependency, and understanding choice. Concepts are important to explain chaos. Tang and Salminen [9] introduce the complexity management approach for the purpose of product and service management in continuous innovation. Both the product and service need to be defined in management architecture before they can be effectively used in configuration according customer and functional requirements [10]. Interoperation is supported by infrastructure model, which includes common semantics and semantics infrastructure [11]. It is important for the management of life cycle business over the customer process life cycle. It consists of customer and functional requirements over the life cycle, product and service features, life cycle functions and operations, modules and components and interfaces [12]. Working closely with the customers and their processes create deep understanding of the customers' value. This life-cycle knowledge is critical success

factor for innovating new solutions and enables punctual innovation [13]. Product and life cycle management architecture as fundamental structure is important to support continuous innovation and business co-evolution [13].

Markopoulos and Vanharanta [14] have created the Company Democracy Model. It can be characterized as a multidisciplinary science, as it integrates many management (strategy, leadership, etc.), engineering (process knowledge, innovation), social (human resources, ethos, etc.), financial (marketing, extroversion, etc.) and other disciplines. The model is structured in such a way that the method reflects the Co-evolute methodology [15] and its application in organizational democratic performance. Evolute LLC provides intelligent web-based system for managing human competences and organizational objects and capability in the world of business.

3 Research Questions and Research Approach

The problems foreseen in synergy management of customer innovations, business innovations and life cycle innovations in a complex, evolutionary business environment led to the following research questions:

- How can the life cycle challenges of the customer process be managed in a networked environment?
- How is the life cycle management architecture structured and how is it used in innovation leadership?
- How can product and service be innovated by integrated way in network environment?
- How can semantic infrastructure be used in life cycle challenge management?

The objective of this article is to introduce a framework for service and product development during various types of innovation in life cycle business evolution routing. When change impulses influence on business it is needed various types of innovations: business, market and life cycle innovation. Knowledge intensive service innovation needs open semantic infrastructure with master-data structures provided by management architecture. The balance in running business is achieved by synergy management.

This applied research has taken as the methodology the qualitative research approach. The study is based on concept creation according to combined industrial and research knowledge and case studies in real industrial environment. The integrated service and product development model has been developed as a joint initiative between research institute experts and various companies and was applied to individual enterprise strategies in order to validate how integrated service and product development can be used to drive business value. The intention has been to provide insight into participant case studies to substantiate breadth of applicability and ease of use.

4 Transdisciplinary and Co-operative Environment

Digitalization changes everything and is a great opportunity to find out competitive advantage in business. Universities of applied science have a good opportunity and central role in supporting the growth of business on the area of industrial digitalization and life cycle care.

The co-operation between government, enterprise and universities is essential for SME-companies to succeed in co-evolution when building up cumulative competence in creation of solutions for circular economy by benefiting digitalization in it. It is also essential to have a common vision to direct the local operation and funding. Otherwise the activities can splinter as small pieces and do not form parts of the whole vision.

Smart services research unit at Häme University of Applied Sciences supports industry, commerce and the society in digitalization and service development needs.

The task of the research unit is to create and execute, together with co-operation network, well-addressed R&D activities for the region and its' enterprises. The Smart Services research unit supports the utilization of digital technologies and service business development across sectors: similar solutions can be adapted in various lines of business.

Region's public and private sector municipal and industrial partners are supported on following six lines of business:

- Industry digitalization and lifecycle services
- Sustainable growth and Circular Economy
- Wellbeing solutions and services
- Flexible logistics and smart traffic
- Smart buildings, home and the environment
- New working environment and lifelong learning.

Research center supports region's public and private sector partners on the creation and co-evolution on one of six business lines Industrial digitalization and life cycle care.

In manufacturing companies technology-oriented competence is on the field of industrial digitalization and lifetime care of supplied application in customer business. Automation system is creating data, which is gathered, clustered, transferred to supplier service center, where a group of experts analyze and compare the data to earlier life cycle information. The expert then makes recommendation on repair or inform that everything is all right in the process. To support this value network process, it is important to have all type of experts in research network. Customer representatives and university experts are involved in the same network.

The substance in the business and partner network is knowledge and capability, which is activated when the customer requirements are decomposed. In order to manage economical and technical risks the innovation should be evaluated as a value for customer and network partners. Effective method of decomposing the requirements reveals precisely. Content management competence, organizational

capability and human mental capability are in strong interrelationship. Each of the entities is planned to parametrize and turn as a questionnaire's. The task of Evolute-tool is to gather and analyze the knowledge needed.

5 Industrial Service Business

The life cycle business is based on a long-term relationship with the customer and the customer process, where the value and emotional aspect are created continuously in a customer partnership. Three life cycle phases in the business exist: beginning of life; middle of life; and end of life. Life cycle services are targeted at customer asset management.

From the value proposition and related offering on each of the life cycle business levels, the life cycle model is defined as a reference model. This model can be utilized when the enterprise- and value network-based life cycle concept is determined. The life cycle concept is a strategy-based enterprise definition and development plan for life cycle business. The value-oriented service share is different for each of the life cycle models. The life cycle concept defines customer value, earning logic in the value network and offering structure. It must be noted that each enterprise in the life cycle business has to manage several life cycle business models at the same time. While the life cycle business is based on new value-creating strategic and long-term customer relationships and partnerships, new offerings are simultaneously created according to the value proposition. Customer business and process co-evolution shifts manufacturing business partners' own business co-evolution towards more knowledge-intensive business with enlarged and more intelligent service and product offerings. The trend is competitive edge in managing an extended enterprise and product concepts with rapidly growing service offerings. This leads to increasing business complexity on all levels: product, service, process, organization, competences, network of partners, and especially management structure.

The main question for service business strategy is the evolution of the customers' business. This means the changes in the customers' business are addressed by the new service solutions. There are different market trends (e.g. technology, market and society trends) that are changing business. Figure 1 illustrates the various types of industrial service business models through which a technology company can grow their business—ranging from product centric towards service and value centric.

Companies competing within the industrial service business market should track the potential and business value that the customer may capture with the aid of services. Based on the expected business value, supplying partner will develop the service offering over the life cycle of customer process.

The mechanism to manage business and adapt products and service offerings is changing. Each of the life cycle business models in Fig. 1 requires a different life cycle management mechanism.

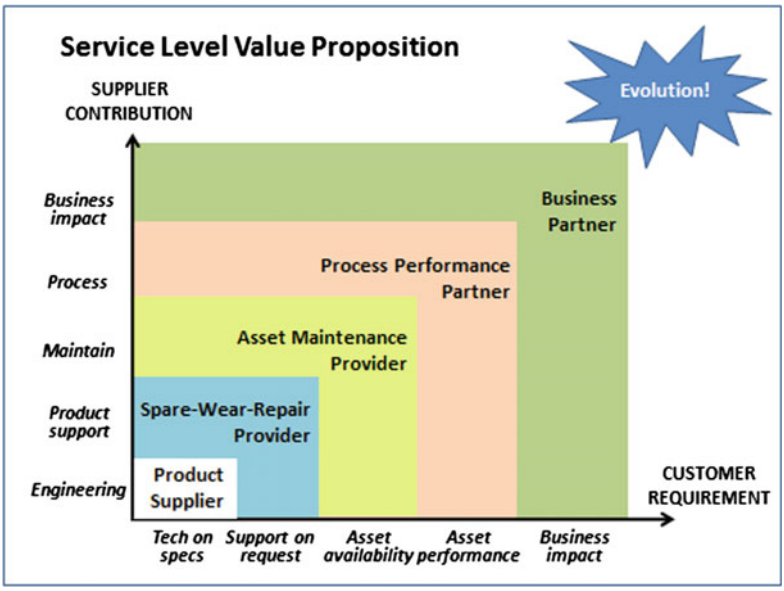


Fig. 1 Business model dependency on customer requirements and value creation

Each of these five business models has its own "mindset". When a supplier (or service provider or partner) aims to proceed from one model to the next, it faces challenges, mostly in terms of getting the customer involved in this and developing its own technical and business competencies in order to achieve the new role. The strategic positioning decision between supplier and customer is important and has to be prepared as thoroughly as any other strategic decision.

Integrated service and product development is essential for lean business co-evolution. Customer and functional requirements, solution and service features, life cycle operations, product and service modules, components and interface definition form a layered structure of life cycle management architecture. Strategic business alignment related to changing requirements and multidisciplinary development activities routes the understanding of new service development influencing on product performance needs and vice versa. Chapter 8 introduces a case study of life cycle management architecture.

6 Industrial Digitalization and Life Cycle Care

This article introduces a concept of integrated service and product development as a complex and dynamic system that needs adaptive interpretation. The model has been created through several industrial case studies and pilots by qualitative

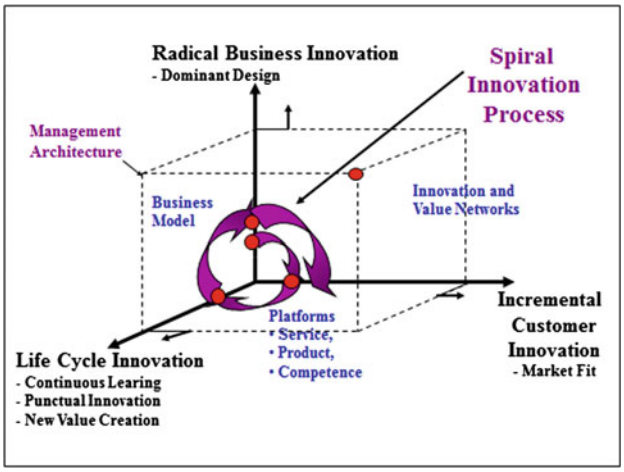


Fig. 2 Integrated service and product innovation over business co-evolution space

research approach. Several types of complexities in service and product innovation exist according to available and constraining requirements. To manage these issues it is important to break down the available configurations into their smallest possible entities (components, modules, elements, etc.) in closed loops to locate, analyze and possibly eliminate unnecessary entities. Figure 2 introduces the concept of integrated product and service development, where business space is determined on three axes: Business Innovation, Customer Innovation and Life Cycle Innovation.

When modelling products and services in a complex environment, items must be first detangled and then reassembled. They are technically screened as one entity while holding their cash-flow aspect in reality. This dynamic approach allows us to view the business operationally.

Business innovation covers new opportunities to create new dominant design and make transition to new business model. Customer innovation builds continuously better market fit according customer value. Life cycle innovation happens over the life cycle of customer process and fit into the changing life cycle requirements. Learning occur according gathered life cycle knowledge. Business innovation is enabling radical changes in dominant designs whereas the nature of customer innovation is incremental. Life cycle innovation is continuous and should be punctual. Punctual open innovation focuses the network partners to the right development activities by routing and converting customer requirements for value and innovation network.

7 Generic Business Model Structure Routing Co-evolution

Combining Business transition need some traceability and generic structures to manage continuous and strategic change. The main functionalities in business transition are managing continuous value creation and proposition earning logic at customer process and customership. It is essential to manage also the semantic infrastructure and information systems supporting service innovation, modelling and productization. Business transition need a generic structured business model (Fig. 3) to route the development activities during the change.

Co-evolution probably is not possible if enterprise and its value network do not build also business structures and common behaviour culture and influence on individual mindset during transition. In open system architecture, the smallest entities can serve as hybrid knowledge units ready to be activated for innovation and new product or service development purposes.

It is obvious, that various boundary objects appear during business co-evolution and hinder the successful implementation. It is important and better to identify them beforehand to avoid the problems (Fig. 4). The interrelation between the elements has to be managed during fluent business transition.

Business strategy is adaptive and needs continuous aligning during coevolution. It is important to understand the whole business structure to create value promise with good emotion in delivery. The promise, however, is not enough; it should also follow by proposition of the value and good emotion produced by business structures is even more important. Competence and capability can be roughly

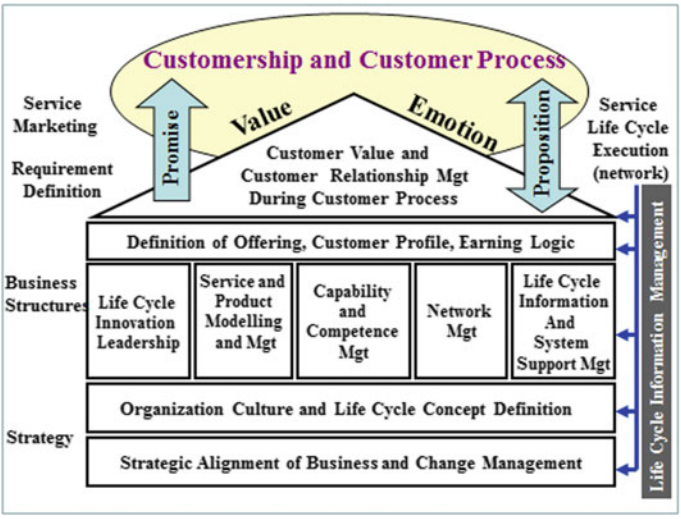


Fig. 3 Generic service business model to support the transition

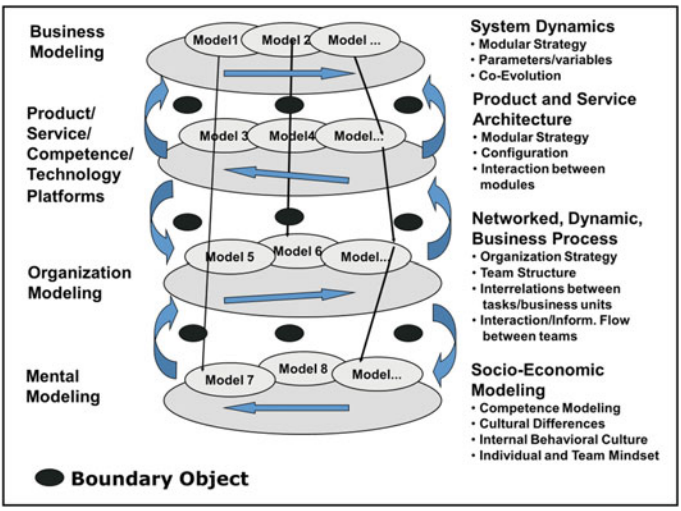


Fig. 4 Boundary objects identified between various modelling layers

categorized into three layers: human competence, organization capability and content management capability [16]. The most difficult changing item, organizational culture, needs a special attention.

8 Case Study on Life Cycle Service—Noatek Corp.

The case study company Noatek Corp. is a supplier of video control systems for high voltage substations. The Finnish electric energy transmission system operator, Fingrid Corp., satisfy the country's increasing need for energy. The distances between the most northerly and southerly substations is abt. 1400 km (870 miles). For field staff it is hard to travel to substation if there occur disturbances or faults [17]. That is the reason Fingrid found out and used partner company Noatek Corp. for developing together with their own experts a more familiar and new procedure for disturbance indication and field service involving video monitoring and remote switching. Noatek Corp. as subcontracting system supplier has been involved on developing the system, install it on substation areas and maintain the system as service provider on life cycle service basis. The service provider responsible for camera indication system of substation and life cycle care has to perform the normal switching operations required for maintenance, development projects of capital system and system faults. Noatek on-call duty staff indicates substations continuously at service center in Helsinki facility. On the case of disturbance, the service center respond to fault situations and orders their own local maintenance supplier to visit the substation if it is required for investigation or

maintenance. Fingrid has the remote-control supervisory control and data acquisition system (SCADA) on which Noatek has integrated their video camera application system (DRC) for managing and controlling switching in various situations. Noatek controls the video stream. Remote control order of disconnector starts XA-DRC-video stream to the service center. The opening or closing of disconnector can be seen in real time. On the case of disturbance or fault the respond time has decrease on only average of 2 h dependent on the place where the substation is. The staff on Fingrid control station has also an opportunity to verify visually the position and operation of primary control equipment, disconnectors and earthing switches. 85 % of Fingrid substations are equipped by video monitoring system. Noatek has developed and productized life cycle services with service center concept (Fig. 5) to support Fingrid.

The service business and life cycle information needs also business structures, which were developed and executed as well. Figure 6 illustrates Life cycle management architecture on requirement, module and component, system, item management and information harmonization level.

Häme University of Applied Sciences as Noatek's development partner has supported Noatek by bringing methodologies, supervising thesis works, experimentation and piloting over the long development cycle of life cycle business concept. It has been essential to create Service Center functionality for the life cycle care.

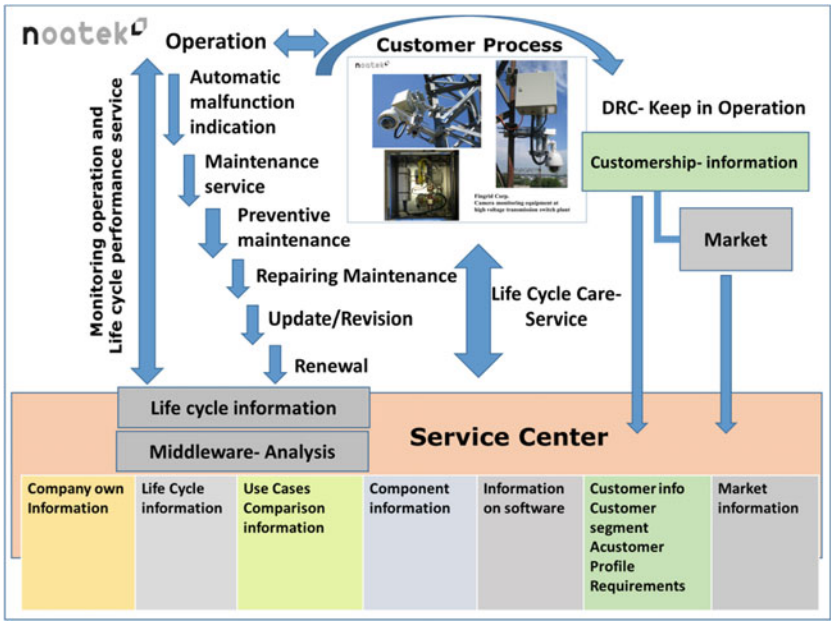


Fig. 5 Service center concept for life cycle performance service

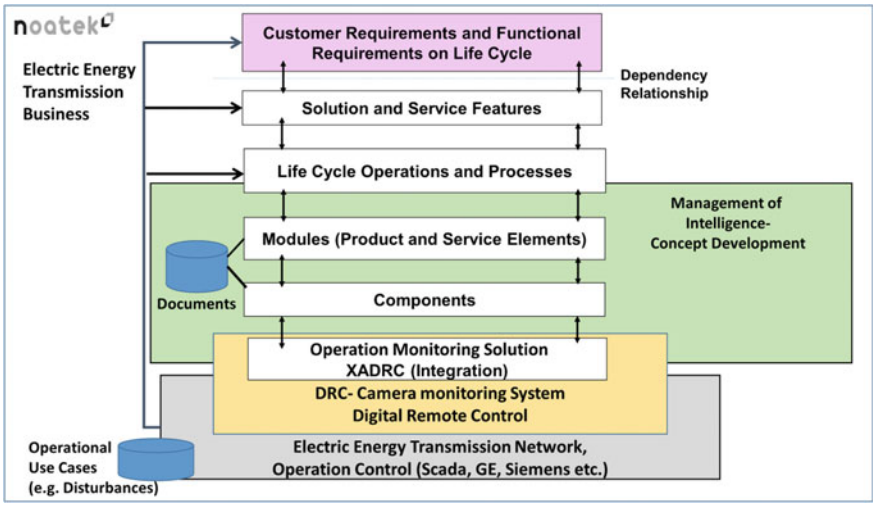


Fig. 6 Life cycle management architecture

It is possible to create dynamic system (Fig. 6), which helps to integrate technology planning by unbundling and identifying technologies within the platforms, linking them in turn to technology road maps. Integrated development systems manage and iterate the platform elements. Product and service is organized in a systematic way and the dependency is exploited in architecture. Platforms are key enablers for continuous introduction of product and service derivatives to multiple market segments. Furthermore, the strategy is critical also when managing the complexity. Dependency is exploited in architecture.

9 Discussion and Conclusions

Industrial innovation has concentrated mostly on customer fit or completely new innovation based on new technology but not so much on continuous life cycle type of innovation. Performance measuring indicators have not been implemented yet on that type of approaches although business transition is difficult to manage without innovation based measuring system. All the concepts created need still more research and industrial validation. In this article has been introduced the concept of integrated product and service innovation over life cycle business co-evolution. Life cycle business requires structures e.g. life cycle management architecture, which reduce the complexity in order to manage continuous business transition. When change impulses influence on business various types of innovations tackle them: business, market and life cycle innovation. Knowledge intensive service innovation needs open semantic infrastructure with masterdata structures provided by life cycle

management architecture. One case study, Noatek video control systems for high voltage substations and related life cycle care service, is described.

References

1. Kumar, V.: Customer life time value—the path to profitability. Found. Trends Market. **2**(1). Now Publishers Inc., Delft (2008)
2. Villaneuva, J., Hanssens D., (2007) Customer equity: measurement, management and research opportunities. Found. Trends Market. **1**(1). Now Publishers Inc, Delft
3. Nonaka, I., Takeuchi, H.: The Knowledge-Creating Company. Oxford University Press, New York (1995)
4. Miller, W., Langdon, M.: Fourth Generation R&D: Managing Knowledge, Technology, and Innovation. Wiley, Canada (1999)
5. Pine, B.J.: Mass Customization. Boston, Massachusetts, USA (1993)
6. Wise, R., Baumgartner, P.: Going downstream: the new profit imperative in manufacturing. Harvard Business Review, September–October (1999)
7. Skyttner, L.: General Systems Theory: Problems, Perspectives, Practices. World Scientific Publishing, Singapore (2005)
8. Jamshid, G.: System thinking: managing chaos and complexity. A platform for designing business architecture. Butterworth-Heinemann, Woburn, MA, USA (1999)
9. Tang, V., Salminen, V.: Towards a theory of complicatedness: framework for complex systems analysis and design. In: 13th International Conference on Engineering Design, ICED 2001, August 21–23 Glasgow, Scotland, UK (2001)
10. Tammela, J., Laitinen, S., Salminen, V., Architecture for life cycle management of product and service. In: International Conference on Product Life Cycle Management PLM 2007, Milano, Italy, July 11–13 (2007)
11. Pallot, M., Salminen, V., Pillai, B., Kulvant B.: Business semantics: the magic instrument enabling plug & play collaboration? In: International Conference on Concurrent Engineering, ICE 2004, June 14–16, Sevilla (2004)
12. Salminen, V., Pillai, B.: Integration of products and services—towards system and performance partner. In: International Conference on Engineering Design, ICED 05, August 15–18, Melbourne, Australia (2005)
13. Salminen, V.: Synergy Management by Hybrid Innovation. Tampere University of Technology, Dissertation Thesis, Publication 859. Tampereen Yliopiston paino, Finland (2009)
14. Markopoulos, E, Vanharanta, H.: Human perception, interpretation, understanding and communication of company democracy. In: 14th International and interdisciplinary Conference of the Research Cooperation, Turku, Finland (2014)
15. Kantola, J., Vanharanta, H., Karwowski, W.: The evolute system: a co-evolutionary human resource development methodology. In: Karwowski, W. (ed.) In the International Encyclopedia of Ergonomics and Human Factors, 2nd edn. CRC Press, Boca Raton, Florida, USA (2006)
16. Salminen, V., Kantola, J., Vanharanta, H.: Competence portfolio assessment of research and development center for regional development. In: 6th International Conference on Applied Human Factors and Ergonomics (AHFE 2015), Las Vegas, USA July 26–30, 2015 (2015)
17. Kuusinen, K.: Virtual Eyes Guide Remote Switching. www.tdworld.com, September 2011 (2011)

Involvement of Accounting Firms in Companies' Innovation Process

Yan Castonguay and Daniel Plamondon

Abstract This study aims to understand the involvement of accounting firms in the innovation process of companies. Based on an exploratory methodological approach, eight semi-structured interviews were conducted between November 2014 and March 2015 with accountants working in accounting firms of different sizes, serving companies in the Chaudière-Appalaches region, province of Québec, Canada. The interviews have shown the entrepreneurs' motivations to innovate, the profile of the initiator of innovative projects, the business profile involving accounting firms in their innovation projects, the entrepreneurs' expectations, the services offered by accounting firms, and their ability to meet entrepreneurs' expectations. This study provides insights to improve the innovation capacity of companies with the involvement of accounting firms. In short, this research makes several contributions to the scientific community, business environment, and accounting firms' environment.

Keywords Accounting firms · Innovation process · SMEs

1 Introduction

Small and medium-sized enterprises (SMEs) face strong international competition. To produce at lower costs and meet the needs of customers constantly desiring novelty, companies must focus on innovation. Innovation plays a key role in business success [1]. Studies of the relationship between firms' accounting environment and their ability to innovate are a new trend in research. The role of the accounting environment is not yet clearly defined in the literature [2]. Traditionally, the accounting environment and the culture of control associated with it were perceived

Y. Castonguay (✉) · D. Plamondon (✉)
University of Quebec at Rimouski, Campus of Levis, 1595, Boulevard Alphonse-Desjardins Levis, Rimouski, Québec G6V 0A6, Canada
e-mail: yan_castonguay@uqar.ca

D. Plamondon
e-mail: daniel_plamondon@uqar.ca

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as restricting for innovation where creativity and flexibility are required [3]. However, recent research shows the relevance of the accounting environment of management and control as a factor that can contribute to innovation within the company [4]. Moreover, innovation is a process facilitated by innovation intermediaries, notably «innovation brokers» [5]. The evaluation of innovations is identified as one of the functions of these intermediaries [6]. Innovation is a process that also involves the search for financial resources, in particular with financial institutions, venture capital firms, private investors, and government agencies. Financial reports, budgets, simulations, and performance analyses will be required to convince and reassure policy-makers, managers, the board of directors, and investors. In addition, research and development work is eligible for tax credits, helping the firm's finance department to promote the start or continuation of such activities. Obtaining these tax credits also requires an expertise that should be supported by the in-house or external accounting environment of the company. The presence of qualified accountants, involved both internally and externally, will help to facilitate the search for funding, to obtain tax credits, and to provide winning conditions for research, development, and innovation. Given their limited resources, the in-house accounting duties of SMEs are more reduced. The management of these companies generally calls on external resources for these services. The presence of external accounting firms that can offer general or specific expert accounting services in support of innovation can compensate for an in-house accounting environment that is little specialized. Therefore, it is reasonable to believe that in order to support their capacity for innovation, companies with limited resources will use external accounting firms more. Until now, few researchers [7] have worked on the impact of the external accounting environment as an intermediary facilitator for innovation. Moreover, it is difficult for companies to be supported by professional accounting services during their various stages of growth [8, 9].

2 The Problem

Professional accountants in companies have the dual role of ensuring the conformity of the firm's accounting management, including the preparation of reliable financial information for stakeholders, but also of proactively supporting the company's management team at the financial level in its core strategies of value creation. This influences the firm's capacity for innovation. In a context of lack of resources and of the obligation of short term performance measures, it is more difficult to provide adequate accounting resources to support management's activities at the desired level. There are also gaps between the users' expectations towards the accounting sector and what the accountants in firms bring in terms of decision support [10]. Furthermore, accounting firms are subject to a budget imposed by the customer firm to render conformity certification services. The offer of complementary consulting services, notably to support the company in the financial aspects of innovation, is influenced by its available financial resources and

the proximity of these accounting firms. This proximity takes into account not only the geographical proximity, but also the relationship of trust established by the external accountant with the manager of the SME over time. This exploratory study aims to identify the perception of external accounting firms on the innovation process of their clients and the role they play as intermediaries.

3 Theoretical Approach

This study is mainly based on the «knowledge-based view» theory [11]. This theory suggests that knowledge is one of the most strategic elements for a firm [12]. It is complex and difficult to imitate. Knowledge offers a competitive advantage to the company that knows how to exploit it. According to this theory, business profits are higher if firms are geographically close to their external sources of information [13]. This theoretical approach supports the works of Porter [14] and Krugman [15] to the effect that the presence of actors with knowledge and state-of-the-art expertise in firms' external environment has an impact on their capacity to innovate. The services of intermediaries such as accounting firms represent an important source of information to increase firms' performance and innovation capacity [7]. However, few studies have attempted to understand the importance of accounting firms in the innovation process.

4 Methodology

Based on a constructivist approach, this research uses an exploratory methodology to understand the role of accounting firms in the innovation process of companies located in the Chaudière-Appalaches region. An interview grid was built and validated by two experts. In addition, this research project received ethics approval by the Ethics Research Committee of the University of Québec at Rimouski. The sample was identified according to the sampling method of reasoned choice. This method allowed to identify good candidates not randomly, but rather based on judgment [16]. The snowball technique was also used to take a sample, thanks to people who know other people who can identify interesting cases. Moreover, we stopped our sample when the addition of the last two interviews did not provide any new information. Thus, eight semi-structured interviews were conducted between November 14th 2014 and March 3rd 2015 with Chartered Professional Accountants (CPA) working in accounting firms of different sizes, serving companies in the Chaudière-Appalaches region. This region currently comprises 2116 companies, including 1136 factories.[1] The interviews were recorded in digital format and their

[1] http://www.icriq.com/fr/ (consulted February 25th 2015).

verbatim texts were transcribed from these recordings. After being anonymized, the data were codified with the help of the Nvivo version 10 software. Finally, the content analysis enabled to understand the importance of the environment of accounting firms in companies' innovation process and to answer research questions [17].

5 Results and Discussion

5.1 Profile of the Innovation Initiator

The entrepreneur's personality often represents a source of intrinsic motivation to innovate. "These entrepreneurs are innovating continuously because it's part of their personality." Interview #2. Several respondents noted that innovative entrepreneurs have strong personalities, they are curious, daring, and know how to discover market opportunities [18]. The analysis of the interviews helped to establish the profile of the innovation initiator. Respondents identified various characteristics of innovation projects' initiators who seek the opinion of accounting firms. These initiators are energetic and positive people who take risks [19]. "They are able to transform a problem into solutions, and they do not let themselves be discouraged by difficulties." Interview #4. The interviews revealed that the initiators who meet with accounting firms to confront their ideas are generally young people, often children of entrepreneurs. The level of education was frequently raised in the interviews. Some initiators have a bachelor's degree. Often, engineers become shareholders and initiators of innovation projects. Other initiators do not graduate. The latter are rather well supported by "good accountants, engineers, or people in marketing. So they are surrounded by people more educated than them." Interview #1. Furthermore, the analysis of the literature revealed the lack of consensus on the impact of a high level of education on corporate performance [20, 21]. Certain researchers demonstrated a positive impact, but others demonstrated the opposite. In short, three types of innovative projects' initiators emerged from the interviews: the manager, the employee, and the accounting firm. Respondents argue that innovation projects are generally the idea of the SME's manager. Sometimes, the idea to innovate stems not from the manager's initiative, but rather the employee's, such as an employee in production, in marketing or even the company's controller. In these situations, the employee is usually not present when the manager meets with his accounting firm to discuss the project, except in the case of an engineer, because "in larger companies where there are engineers, engineers are often the people who will implement innovation." Interview #5. Moreover, it happens in some cases that the initiator of the innovation project is the external accountant. The accounting firm acts as a facilitator. The interviews enabled to not only draw the profile of the innovation's initiator, but also the profile of an innovative company using the services of an accounting firm in its innovation process.

5.2 Profile of the Innovative Company

The analysis of the interviews allowed the profiling of the innovative company. The various features of the innovative company seeking the opinion of accounting firms were identified. Respondents identified two moments when managers rely more on accounting firms: after the first 5 years of existence and during a business transfer. When companies reach a generation transfer stage, new managers rely more on accounting firms than other business managers. The arrival of a new generation in the firm is a trigger point prompting the company to reinvent itself and innovate. The size of the company was also discussed during the interviews. Small-sized companies do not have in-house financial analysts or accountants. Therefore, large companies have more in-house resources, which is reflected in their capacity for innovation [22]. During an innovation project, SMEs need more assistance from an accounting firm than larger companies. However, some respondents pointed out that although very small firms may need the services of an accounting firm in their innovation process, they use their services very little, which is mainly due to their limited financial resources. Also, companies referred to their accounting firm when their innovation project reached a certain size or a certain level of investment. In addition, companies that need assistance from their accounting firm in their innovation process stem from various industries. There do not appear to be distinctive industries that push firms into validating their ideas with accounting firms. It is more the company's growth phase that encourages companies to solicit their support.

5.3 Entrepreneurs' Expectations

SMEs, mainly those that are not equipped with in-house accountants able to support them in their decision-making, need help in the different phases of their innovation project.

5.4 Search for Support

The reflex to consult and to get an external opinion is evident among several entrepreneurs. They often feel isolated when important decisions are made. Managers-owners are interested in receiving expert advice from their accounting firm so as to be challenged in their decision-making process.

5.5 In Need of an Expert

There is a lack of expertise in SMEs when the accounting is carried out by the technical staff assigned to the everyday operations of bookkeeping, production of

payroll, payment transactions to suppliers, and customers' bill collection. In addition to the availability of a professional accountant, the entrepreneur also seeks a specialized expertise for aspects unknown to his in-house staff such as innovation funding and the financial analysis to assess the potential of an innovation project. Moreover, Zhang and Li [7] point out that the services of intermediaries such as accounting firms can meet these needs for expertise.

5.6 *Exchange and Validation with an Independent Professional*

The pressure of competition, especially international competition, forces companies to constantly innovate [23]. Some entrepreneurs also meet with their accounting firms to gain access to external markets. Also, a company might be compelled to review its positioning [23]. To succeed in their positioning, companies meet with their accounting firm to validate their innovation idea [7]. The confidentiality of certain projects encourages managers to seek the opinion of an accountant who is bound by professional secrecy. The accountant is thus invited to participate in discussions related to the innovation project with the company's management committee. The manager sometimes finds himself in an environment where the exchange and confrontation of ideas for a new innovation project are not always ideal. The manager often feels alone in the decision-making process. He enjoys sharing with his accountant who acts as a professional confidante. Inevitably, for this complicity to be established with his accountant, there must be a relationship of trust that has developed over the years.

5.7 *Limited Expectations*

For some entrepreneurs, expectations are rather low towards their external accountant. Various reasons seem to explain this situation. On the one hand, the accountant is perceived as a professional, associated with services limited to the certification of financial statements and the preparation of tax returns for the tax authorities [7]. Some accounting firms have accustomed their clients to this relationship guided by regulatory requirements. Moreover, some entrepreneurs are aware that professional accounting services are expensive. Several of them systematically seek cheaper advice. On the other hand, because of the limited resources of some accounting firms and the large volume of the current business of these firms, the external accountant has accustomed his clients to a standardized and timely service during the year. In these cases, the external accountant is little or not involved in the innovation projects of the entrepreneur who does not see the added value of the professional.

5.8 Services Provided by Accounting Firms

In the framework of the entrepreneur's projects, the external accountant is called upon to deliver a variety of professional services that will help the company to start, advance or complete its innovation project [7]. These services vary according to the entrepreneur's expectations of his accounting firm and the moment he wishes the accountant to intervene. When an idea is launched or an innovation project is reviewed, some entrepreneurs will want to share their vision of the project with an external accountant. Entrepreneurs will want, with the help of their external accountant, to identify the stages of the innovation project, assess the required investment or analyze the opportunity and profitability of the project. Other services such as the evaluation of funding opportunities as well as tax-related advice, including credits for research and development, will also be provided by the external accountants. In short, the intermediaries, such as the accounting firm, take a broader role in firms' innovation process.

5.9 Preparation of Financial Forecasts

For some entrepreneurs, the innovation project is relatively well defined. They ask their external accountant to prepare realistic financial forecasts to convince other shareholders of the relevance of their proposal. Entrepreneurs also need the external accountant to find funding from bankers and investors. In other situations, the project is in the idea stage. Entrepreneurs will therefore seek to be guided through the process steps and cost estimations.

5.10 Contact with Different Actors

Accounting firms are at the core of business affairs and their different professional interventions for all of their clientele lead them to develop a strong network of contacts [24]. Their most daring customers, willing to carry out innovation projects, can take advantage of this network. This can result in putting customers in contact with financial institutions, venture capital firms, support organizations or private investors.

5.11 Distribution of Mandate

The external accountant will be the link with the other partners of his accounting firm, especially when the client's need is based on specialized services that the

former is unable to deliver. In smaller accounting firms, the external accountant, who doesn't have the expertise, usually refers his customer to another trusted firm. In short, the accounting firm occasionally acts as a mandate dispatcher agent.

5.12 Financing Assistance

For accounting firms, the services related to the search for funding include the preparation of the financing strategies by supporting the entrepreneur in his budget forecasts of funding goals aimed at bankers, venture capital companies or potential investors. By his business knowledge and expertise, the external accountant is able to help the entrepreneur prepare well-documented financial projections that meet the expectations of future partners in the project. The external accountant brings rigor and a specialized expertise that in-house resources of SMEs do not always possess. Moreover, his independence from the project leads him to be more critical of the entrepreneur's assumptions. His contribution often adds rigor and credibility to the financial forecasts. This often helps advance the process of securing the funds needed to start the innovation project.

5.13 Help to Obtain a Tax Credit for Research and Development

Except for some accounting firms, we find that the dossier preparation for a research and development credit claim is not a widespread service offered in accounting firms. For many of these, the business volume in this domain does not justify offering this service. The main contribution of the accounting firm is then to educate the entrepreneur to the fact that certain expenses linked to the innovation project qualify as a tax credit for research and development. Accounting firms prefer to refer their client to a specialized firm, often engineers or lawyers, to prepare the tax credit claim. The accounting firm often limits itself to registering the claimed amount on the company's tax form.

5.14 General Services

Some entrepreneurs inform their accounting firm of their finished projects only at the end of the fiscal year. The external accountant is only informed of the implemented innovation projects when he comes to give the basic services related to the certification of the financial statements and tax preparation.

In short, the contribution of the external accountant to the innovation project is not only limited to giving the entrepreneur a general service so he can benefit from all the tax credits related to research and development. The entrepreneur can also count on the accounting firm for the preparation of the financial projections related to the innovation project, and for the search for financial aid and tax credits related to R & D. The accounting firm can also play the role of facilitator and mandate distributor with other specialized firms.

5.15 Capacity to Support Entrepreneurs

Accounting firms are not all equal in their capacity to support entrepreneurs in their innovation projects. Nevertheless, they all agree on the importance of supporting SMEs in their innovation projects. Firms need support, especially small firms.

5.16 Trust

To meet the needs of SMEs, it is necessary to develop a close relationship and trust with the entrepreneur. To achieve this, one must be able to act without questioning his independence, especially with certification mandates. The capacity to support entrepreneurs in their innovation projects is therefore based primarily on trust.

5.17 Available Professional Resources

When an external accountant is appointed by the shareholders as auditor of a private company, he cannot provide consulting services that could cast doubt on his independence as an auditor. In these cases, accounting firms establish independence-safeguard measures, notably by allowing another partner in the firm, not involved in the audit, to provide the service. This partner is normally specialized in the service requested by the customer. Other accounting firms prefer to let the customer get the service from another accounting firm as is required when a firm acts as auditor of a public company. Some accounting firms do not always have the specialized resources or are experienced enough to accompany the entrepreneur when required. These claims require experience and special expertise that must be entrusted to a more experienced external accountant. There are periods during the year that require the expertise of external accountants with experience. Therefore, these resources are not easily available.

5.18 Cost Constraint

Some entrepreneurs seek advice at low prices for basic services, annual tax returns, and financial statements. They may be reluctant to discuss or analyze financial statements or any kind of problem with their external accountant, knowing that fees might be charged. In these cases, it is clear that the external accountant was not able to convince the entrepreneur of the added value of his advice.

5.19 Types of Accounting Firms

The interviewed accountants believe that the size of the accounting firm will have a direct impact on the types of services offered to the entrepreneur. According to the collected opinions, small accounting firms are likely to offer only basic services in accounting: bookkeeping, preparation of financial statements, and tax returns for individuals and corporations. Given the business model based on the volume of customers, practitioners of these accounting firms usually provide little or no support to the development of entrepreneurs' innovation projects. Not being regularly exposed to certain problems, it is more difficult for smaller accounting firms to identify the customer's specific need for innovation support. Medium-sized accounting firms of 100 to 500 people are firms with multiple professional accountants having developed, as part of their business practice, special interests and expertise in specialized consultant services. The practitioners of these firms know both their customers' needs and the expertise developed by their colleagues, so they can combine the firm's expertise to properly support their clients in advancing their projects. Finally, there are large firms of more than 500 people, including notably the "Big Four".[2] These firms count many skilled professionals covering all consultant services and they are pooled by specialty departments. These firms are usually concentrated in large cities, but they can make such services available to their customers who are based outside the area. Indeed, some respondents argued that the specialized services of large accounting firms are sometimes located geographically away from customers.

6 Limits and Future Research

It is important to note that this research focuses on accounting firms serving companies in the Chaudière-Appalaches region. This region is economically dynamic. Its gross domestic product amounted to 15.7 billion Canadian dollars,[3]

[2]Big Four: Deloitte Touche Tohmatsu, Ernst & Young, KPMG et PricewaterhouseCoopers.

[3]http://www.stat.gouv.qc.ca/statistiques/economie/comptes-economiques/comptes-production/pib-regional-industrie.html (consulted on January 20, 2016).

which puts this region in 5th place of the 17 regions of Québec. The majority of firms in this region are SMEs 98.2 % [25], compared to 99.8 % in 2014 for Québec and 99.8 % in 2014 for Canada.[4] Considering the similar context of accounting firms in the Chaudière-Appalaches region, in the Province of Québec and in Canada, the results of this research can inspire other similar environments with a high level of SMEs.

Nevertheless, the results of this study only reflect the point of view of accounting firms about their involvement in companies' innovation process. It would be appropriate, in future research, to study the companies' perspective on the involvement of accounting firms. Considering the results of the interviews, the points of view of small companies, of medium-sized and large companies would validate that the involvement of accounting firms in the innovation process is probably not the same, depending on the size of the companies and especially on the level of the in-house accounting expertise.

7 Conclusion

This research has allowed to understand the involvement of accounting firms in companies' innovation process. Some stages of the entrepreneur's lifecycle seem to require more support from accounting firms. Indeed, companies require more advice related to innovation, from accounting firms, after their first 5 years of existence or when they are in a business transfer process. Furthermore, research results suggest that firms which do not have sufficient in-house accounting expertise use accounting firms more to validate their process of innovation. The entrepreneur seeks the opinion of an independent professional able to be critical and to advance the project. The main services provided by accounting firms concern feasibility studies, financial forecasting, and search for funding. There also seems to be a consensus on the ability of accounting firms to support entrepreneurs in their innovation process. According to respondents, accounting firms of a smaller size typically do not have the resources nor the expertise of medium- or large-sized accounting firms to support the entrepreneur in his innovation projects. These results lead us to question the perception of entrepreneurs on the involvement of accounting firms in their innovation process.

References

1. St-Pierre, K.: L'innovation dans les entreprises du secteur de la fabrication selon la taille et la productivité de l'emploi. Québec: Direction des statistiques économiques et sociales. Institut de la statistique du Québec (2002)
2. Kuecher, A.: Management accounting and control in innovative setting—a help or handicap? Int. J. Bus. Res. **13**, 101–114 (2013)

[4] http://www.ic.gc.ca/eic/site/061.nsf/fra/02804.html (consulted on January 20, 2016).

3. Bisbe, J., Otley, D.: The effect of the interactive use of management control systems on product innovation. Account. Organ. Soc. **29**, 709–737 (2004)
4. Davila, A., Foster, G., Li, M.: Reasons for management control systems adoption: insights from product development systems choice by early-stage entrepreneurial companies. Account. Organ. Soc. **34**, 322–347 (2009)
5. Chesbrough, H., Vanhaverbeke, W., West, J.: Open Innovation: Researching a New Paradigm. Oxford University Press, New York (2006)
6. Howells, J.: Intermediation and the role of intermediaries in innovation. Res. Policy **35**, 715–728 (2006)
7. Zhang, Y., Li, H.: Innovation search of new ventures in a technology cluster: the role of ties with service intermediaries. Strateg. Manag. J. **31**, 88–109 (2010)
8. Bentley, K.A., Omer, T.C., Sharp, N.Y.: Business strategy, financial reporting irregularities, and audit effort. Contemp. Account. Res. **30**, 780–817 (2012)
9. Gani, L., Jermias, J.: The effects of strategy-management control system misfits on firm performance. Accounting Perspect./Perspect. Compat. **11**, 165–196 (2012)
10. Walker, K.B., Fleischman, G.M., Johnson, E.N.: Measuring management accounting service quality. Manag. Account. Q. **13**, 15–27 (2012)
11. Dangelico, R.M., Garavelli, A.C., Petruzzelli, A.M.: A system dynamics model to analyze technology districts' evolution in a knowledge-based perspective. Technovation **30**, 142–153 (2010)
12. Felin, T., Hesterly, W.S.: The knowledge-based view, nested heterogeneity, and new value creation: philosophical considerations on the focus of knowledge. Acad. Manag. Rev. **32**, 195–218 (2007)
13. Rosa, J., Mohnen, M.: Knowledge transfers between canadian business enterprises and universities: does distance matter? UNU-MERIT Working Paper# 2008-17 (2008)
14. Porter, M.: The Competitive Advantage of Nations. MacMillan Press, London (1990)
15. Krugman, P.: Geography and Trade. MIT Press, Cambridge (1991)
16. Thiétart, R-A., coll.: Méthodes de recherche en management. 2e édition Dunod, Paris (2003)
17. Miles, M.B., Huberman, A.M.: Analyse des données qualitatives. De Boeck Supérieur, Paris (2003)
18. Basso, O.: La face obscure de l'intrapreneuriat: héroïsme et sacrifice de soi dans l'entreprise. Gestion 2000. July/August, 179–182 (2005)
19. BarNir, A.: Starting technologically innovative ventures: reasons, human capital, and gender. Manag. Decis. **50**, 399–419 (2012)
20. Soriano, D.R., Castrogiovanni, G.J.: The impact of education, experience and inner circle advisors on SME performance: insights from a study of public development centers. Small Bus. Econ. **38**, 333–349 (2012)
21. Castonguay, Y.: The effects of export and organizational context on the firm's performance. Macrotheme Rev. **4**, 84–98 (2015)
22. Baldwin, J.R., Gu, W.: Innovation, survival and performance of canadian manufacturing plants. economic analysis. Research Paper. No 22, 1–49 (2004)
23. Hull, C.E., Rothenberg, S.: Firm performance: the interactions of corporate social performance with innovation and industry differentiation. Strateg. Manag. J. **29**, 781–789 (2008)
24. Bahrami, H., Evans, S.: Flexible re-cycling and high-technology entrepreneurship. Calif. Manag. Rev. **37**, 62–89 (1995)
25. Castonguay, Y.: Priorization of proximities and innovation. Eur. J. Manag. **14**, 75–82 (2014)

Jewelry Packages: Some Interpolations on Design and Form

Silvia Rocha, Maria Benutti and Roberto Nascimento

Abstract The study explores the efficiency of jewelery packages in the consumer's home. The counterpoint of this proposal is in the interdisciplinary transit between design and the study of form. Smart packaging that stimulates new interactions with the user in their home ambient and an environmental awareness is possible. The possibilities for jewelry packaging described here, can instigate innovative thoughts toward a less voracious and induced consumption. The qualitative field research and literature review under the design scope led at first to projects investigation with a bias in geometric formulations.

Keywords Packaging · Jewelry · Design · Geometry

1 Introduction

Objects with different geometric shapes are part of the history of civilizations. In contemporary times, in the frenzy of a world with strong consumer habits, a considerable part of this universe is occupied by packaging. According to a popular saying says: "The first impression is the one that lasts". Another widespread thought is that through the packaging must "impress the consumer's eyes," that is, it must meet the aesthetic and economic sense, be easy to handle, add value to the presentation of the product through the observation of its shape.

S. Rocha (✉) · M. Benutti · R. Nascimento
UNESP, Paulista State University Julio Mesquita Filho,
Avenida Eng. Luiz Edmundo Carrijo Cobe, 14-01, Bauru,
São Paulo CEP 17033-360, Brazil
e-mail: silcsrocha@gmail.com

M. Benutti
e-mail: mariabenutti@gmail.com

R. Nascimento
e-mail: alcarria@faac.unesp.br

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As a complement to the function of the object, Ventura and Vicente [1] mention the need for it to be resistant and to protect the product from damages during transportation and from the weather. On the other hand, in 1950, Dr. Ruben Rausing, the founder of Tetra Pak, said: "a package should generate more saving than its cost." This reflects a concern for creating packaging that uses a minimum amount of material without losing functionality and resistance.

This statement invites a reflection on the current jewelry packaging. In the jewelry sector, packaging protects and enhances the beauty of the product causing seduction and dazzlement. The packaging object is designed to be aesthetically compatible with the product for which it is intended. But the initial ecstasy generally becomes a nuisance—the ravishing box is in the end abandoned as it does not have a shape that justifies its use in its final home. In the 21st century, given the technological advances it is limited to consider luxury only in terms of appearance. Rigid postures can be reconsidered, in which the jewelry box must have, at any cost, aesthetic refinement, durability and ostentate something similar to the ornament it holds.

The packaging sector, by its dimension and reach, has the condition to propose pertinent solutions with a more refined observation of its structure. It is auspicious to associate sophistication to coherence in the definition of shape and materials. Shape, protection, storage and the use of a unique material, when worked on with some special care, may be consistent with balance, elegance and efficiency not losing the value of the piece in its glamour.

Even the size of the boxes and bags may be re-evaluated aiming at a reduction. In this sense, planning based on geometric principles may solve part of the problem under discussion. The basic goal of the sector should be to better ascertain the full life cycle of the product without compromising any function. The object of this argument is to show some points of the complex situation concerning this packaging and make a counterpoint to the pomp, aesthetics, seduction, disposal, shape and material.

This research is based on an empirical, qualitative methodology, developed from gathering of field data, through interviews, photos and from samples of packaging and products. Information was collected during visits to stores and professional associations. The information gathered was compared and confronted with bibliographical references in the areas of jewelry, geometry, production engineering, design, materials, disposal and innovation.

It was evidenced that much of the jewelry packaging is expensive and continue to have a traditionalist look to justify the value of the product. At first, the aesthetic transformations over the years have been contained and delayed. Questions relating to the design, a smaller and more economical structure, to the material and other relevant items in the context of jewelry packaging have not been explored in all its possibilities.

They remained outside the goals of innovation despite the intense technological progress and the easy exchange of knowledge among different areas. It is possible and necessary the search for packaging that would include concepts to encourage changes by the intelligent use of shape and unique material with a focus on a

friendly disposal. As Bonsiepe [2] argues that cultures are generated and reproduced between the symbolic and technologic, between discursive and the iconic.

What can be done to address the issue of expensive packaging which ends up left aside? What is the viable analysis for this situation of stagnation in the development of these products? Can the lush appearance of the packaging today make them indispensable? Can the concept of what luxury is be turned into a new understanding of it? If the jewelry is not accompanied by a lavish package will the customer actually stop buying that adornment?

2 Packaging, Design and Shape

In the proposition of Ventura and Vicenti [1], the description, representation or world location in which we live through geometric shapes enables us to understand it in a more integrated and fully manner. Thus, this thought allows us to make connections at the same time between Mathematics and other fields of knowledge, including the exploration of objects from the physical world, works of art, paintings, drawings, sculptures and crafts in the context of design, and, as a consequence, of packaging.

The term packaging encompasses everything that serves to pack a product. Its manufacture makes use of materials like vegetable leaf in natura, ceramics, glass, wood, metal, cloth, paper and plastic. In the context of human life, product and packaging have a very close and beneficial association. By observing the consumer code in the contemporary world, it is not feasible to sell products in any odd way.

Roncarelli and Ellicott [3] argue that the packaging makes the connection between the product and the client, creating a dialogue on the emotional and logical level through strategies linked to the design. According to the authors, a line of products with good design reaches a wide segment of the target audience, preserving the attributes of the brand. In this sense, the tools applied are color, shape, graphics, words and even smells.

When we think in terms of jewelry there are examples of packaging generally used in the commerce and that cause a frisson of excitement mainly among women simply because of its color. Despite the exceptional development of the sector and the attractiveness of these objects, it is interesting to think about what happens to the jewelry packaging, usually ostentatious and expensive, with a not so friendly way to keep it in the customer's home.

It is easy to understand that packaging currently does not incorporate all the aspects related to shape, function and disposal. In the user's residence, this object is usually thrown in a corner of the cupboard or drawer, as something that has totally lost its function. It is a fact that evolution happened more in terms of pomp and aesthetics than practicality, functionality or disposal. The use of some materials and more advantageous shapes no longer justify more waste and environmental pollution.

Twede and Goddard [4] have demonstrated that in addition to the raw material used in the manufacture of packaging, other considerable volumes of resources are

devoted to their purification and processing. In terms of transportation and safe storage, these objects require fillers, closures and disposal systems, which implies spending on other resources.

In general, conventional packaging used in jewelry is difficult to dispose of, considering the slow degradation materials used such as fabric, plastic, and metal. Many of them still need extra protection, usually paper. A third resistant packaging may be necessary to protect against dirt and moisture, most often using plastic material.

Therefore, the system uses at least three containers for a single object. But is it worth wondering whether this sale actually took place due to the quantity of packaging used? Roncarelli and Ellicott [3] suggest that two-thirds of the population prefer recyclable packaging and would be willing to pay more for environmentally responsible packaging.

It is a priority to minimize the excessive use of boxes and bags in order to harm as little as possible the balance of the environment. Handling should be more in line with other realities and not only with the rampant economic development.

Chanel has always advocated that "luxury must be comfortable or is not luxury".[1] As suggested by Roncarelli and Ellicott [3], this concept can be linked to the three R's: reduce, reuse and recycle. It may be a delicate question to ask whether cost, luxury, beauty and large quantities of packaging are compatible with the environment of housing, with consumers' habits and with the society's real priorities in such a grandiose economy, however, this reflection is essential. The situation of jewelry packaging suggests changes and more compatible alternatives to disuse and waste.

It is plausible to arbitrate on this object in a more effectively way through the compilation of knowledge from different areas orchestrated by the design and the use of shapes. The substrate of the design is shape. According to Braida and Nojima [5], in the triad shape, meaning and function, the design seeks to answer or meet human needs.

There are relevant points in this hybridization such as: material, cost, technology, aesthetic qualities, emotional, socio-cultural, semantic and symbolic aspects, usage behavior, enriching of functions, maintenance, durability, reliability and safety. Design considers the commitment to life through the planning of projects and services. Shape, as a term, has a polysemous definition.

Shape according to Ching [6], is related to an external appearance. It may allude to a particular condition in which something acts or manifests itself, in the same way as when we speak of water in the shape of ice or steam. Or even in the case of arts or a project, the term is used to denote the formal structure of the work executed—the way to arrange and coordinate the elements and parts of a composition to arrive at a coherent image.

Lefevre [7] categorically states that there is no shape without content and the reverse is also true, that is, there is no content without shape. In this sense one

[1]Makes Arts Music's, https://makeam.wordpress.com/2012/03/17/coco-chanel/.

hypothesis is that objects and living things synthesize a material arrangement, through the organization of its internal elements that guide the external structure. This frame serves as support for the shape and is linked to geometry. This thought is represented by the structures found in fruit or flowers, in the human body, in the internal arrangements of buildings, and roofs.

Neto [8] argues that the geometry is constantly present in our lives. There is always a figure, an angle, an area, a volume to be calculated, a measure to be checked, or a space to be innovated. Geometric thoughts make transformations possible. They establish interesting constructions with more adaptable and versatile resolutions.

According to Bueno [9], the notion of measures, location, rotation, displacement, representation of objects or beings are enhanced with geometry. Packaging brings significant content related to spatial and plane geometry, it suffices only to think about any type of box.

Loureiro [10] emphasizes the idea that we sharpen the perception, spatial reasoning and the ability of observation and visual understanding of space, to a greater or lesser degree, when we consider references that result from geometry studies. According to Pythagoras, "everything is organized according to numbers and geometric shapes".

Skills such as looking, measuring, comparing, guessing, generalizing and abstracting are exacerbated, that is, having a keen spatial awareness, autonomous critical thought and agility in solving problems. "Because Geometry is one of the best opportunities that exist to learn how to materialize reality" [11].

In establishing resources in the design project, it becomes clear that this knowledge may potentialize the development of various suppositions, as all forms are ordered by a structural arrangement established in space. Within geometry, design includes some practices that are highlighted due to their excellent results as follows:

2.1 The Strategy of the Meshes

As seen in Barison [12] it can be stated that the strategy of meshes is one of the viable alternatives because by applying modular symmetries it is possible to save time and creation, simplify production and have better options for handling, storage or disposal. The resistance is also enhanced by employing meshes with triangular polygons, for example.

However hexagonal mesh may be the best indication when you want to use a smaller amount of material or a unique material. It is less dense, it does not compromise the robustness and adapt better to the curves. Another advantage is that flat mesh may be deformed in one or more directions, generating mosaics. In this sense, unique references are the work (kaleidocycles) of the graphic artist Maurits Cornelis Escher.

The juxtaposition of fragments, or combination of figures, or of geometric modules following symmetrical patterns, may be another good application in the case of packaging that mainly require the contemplation of other shapes that are more organic and work with pieces that fit. This configuration becomes interesting as it represents a saving, since the proposal does not need extra device for its closure.

2.2 Shape Grammar

Morais [13] mentions that the project is a process that seeks to solve problems and can be developed in various ways, including by computer, with indirect use of generative systems based on algorithms such as the case of shape grammar. The method enables the insertion of parameters, rules and criteria so that the computer may solve similar problems in different contexts. The inclusion of parameters at every moment, imprints flexibility in the design and generation of multiple possibilities through analysis and comparison. According to Celani [14] the generative systems can be used in three different situations:

- *in optimization of solutions* when the criteria are clearly defined, but there is no direct method to find the solution—so an alternative is to generate and test the possibilities until you find the solution that best contemplate the established criteria;
- *in the generation of families of objects*, when it is necessary to create variety—it consists in producing a number of similar solutions, but with some differences (this is a common type of problem in the area of industrial design);
- *in the exploration of problems* when the solution criteria are not well defined—in this case, it is important to look for different possibilities and then assess the pros and cons of each solution. These possibilities can fit in the search of shapes and styles best suit the packaging of jewelry.

As seen in Celani et al. [15], Gips [16] and Knight and Stiny [17], shape grammar is characterized by the appreciation of the geometric aspect as the results obtained with the visual experience and aesthetics reinforce shape and content. Its use may be aimed both at the analysis of existing projects such as the development of a new architectural design language.

Its design process is basically translated into modifications (addition, subtraction, relocation) of finite elements and in the definition or modification of existing relationships among these elements based on rules with the generation of juxtapositions, symmetries, rotations or translation.

According to Gips [16] and Knight and Stiny [17], four basic components are required to develop a shape grammar: a finite set of shapes, a finite set of spatial relationships, a finite set of rules and an initial shape. Once the definition of these elements is finalized, the successive application of rules on the initial shape selected begins until the desired composition is obtained [14].

2.3 Biomimicry

The concept involves notions of proportion and shape, related in harmonic arrangements that are found in nature. These accurate and regular characteristics are known as sacred geometry. These references make it possible, for example, to analyze the efficiency of shape and reach the most appropriate choices of materials within the scope of economically sustainable production.

Proportions and thicknesses can be simulated on the computer with the use of geometric shapes producing a wide repertoire of the relationship among structure, material and function. According to Brandão [18], these signs, patterns and logic appear in nature, and are designated sacred or divine proportions. And this perfection awakens human curiosity.

Nature holds precious teachings. In it, resistance, harmony and beauty go together without excess or waste. Packaging using geometric shapes found in nature is something common in our daily life and we do not even realize it.

As seen in Ventura and Vicente [1] it can be reaffirmed that geometry is present in nature, in everyday objects, that is, in several activities related to animal, vegetal or human life. And it is clear that these patterns, with surprisingly beautiful perfection, have geometric configurations that range from a simple to a more daring context. This knowledge has wide applicability in the context of jewelry packaging.

Costa [19] mentions Gestalt to confirm that nature displays harmonious proportions that are models in the search for an ideal setting. For the author, shape as visual language is used as a strategy to identify and provide personality to the product.

It is a fact that human beings use the perception to acquire, interpret, select and organize sensory information. These numerical formulations can still be found in the aesthetic standard of artwork, architecture or music. They are interesting references for design and packaging.

Brandão [18] mentions that Plato and Aristotle resorted in their studies to mimesis: the imitation of the essence of the world or of nature. At that time, the first logical and analytical observation methods were structured, with the intention to transform.

Today, this proposal is represented by biomimicry. Expressed as a method of observing nature for the development of processes, products, technologies, management and results, it has already resulted in widely spread solutions, as is the case of velcro.

The biomimicry and the search for solutions from the sharing of information are accessible reality. We have in nature an open-air collection, where everyone can investigate and explore the most varied suppositions for the challenges of design. In it rotations, translations, symmetries or plans encourage a more resourceful thought. According to Ramos and Ramos [20], it may be seen that with no exceptions we use geometric thoughts in life, intuitively or by premeditation.

3 Final Considerations

Nowadays, practically to consume means to exist and the packaging of jewelry is seen as a luxurious aesthetics, thoroughly elaborated in order to add value the ornament and to encourage and facilitate sales.

Its function goes beyond those basic principles regarding the provision of information, protection and transportation. In the market, because the strong competition among products, it often works as something attractive.

In this context, the constant search for innovation many times permeates the use of sophisticated materials. With this, other aspects related to the complete life cycle of this object are relegated to the background as is the case with what happens after the jewelry is bought and reaches its final destination.

It is a fact that transporting the objects depends on packaging whatever it may be. The worldwide expressive consumption consolidates the importance of this economy, with its significant dimensions. Because it is considered relevant signs of increase and decrease of commerce in society, it is necessary to include some innovations in the parameters orbiting its production, as they affect life on the planet.

The transversality of processes that involves this subject permeates emotional, social, economic, cultural and environmental aspects and must be constant demand.

It is difficult to accept that the glamorous aspect that accompanies the packaging disappears or is worthless in everyday context, as it involves touching in the imaginary, signs and relationships that these objects awake.

The conflicting feelings generated after going through the point of ecstasy are complemented by the constraint of its difficult disposal. Abandoning it in any corner strengthens the behavior that the problem does not exist.

The concept in the design linked to the good shape reveals a desire for innovations regarding the values attributed to objects. These concerns related to the excessive consumption, the finiteness of materials and pollution express the resumption of balance between formalism and functionalism.

The refined aesthetic guiding forms, content and meaning can base on the subject-object relationship with connections that shape the reality of the twenty-first century. It is part of the language that the design establishes to consider pragmatic that which involves such a complex product, in all its dimensions, which means, in their entire life cycle.

The geometry so present in human life and in nature is, in many aspects, a fundamental knowledge in this exercise, as it eases and speeds up thinking, creative logic.

Shape abstracted from a more shrewd, tirocinium, as is promoted with geometry, when it appears associated with technological development, may be the determining arrangement of good aesthetics associated with intelligent luxury.

The employment practices and principles that question distorted behaviors and minimize waste are substrates for the consolidation of this virtuoso, innovative and sustainable cycle.

In man's relationship with himself and with the universe around him, thoughts are built, experienced, analyzed and understood through geometric language.

The design adopts signs and symbols expressed as products that actually tell the story of humanity and are critical to mediate, to bridge the gap with practical and abstract aspects of a less unsettling future for the next generations.

References

1. Ventura, A., Vicente, A.: O Ensino da Geometria com o Uso das Embalagens. Cascavel, pp. 3–18. Universidade Estadual do Oeste do Paraná (2007) http://www.diaadiaeducacao.pr.gov.br/portals/pde/arquivos/899-4.pdf
2. Bonsieppe, G.: Design. Cultura e Sociedade. Edgard Blücher, São Paulo (2011)
3. Roncarelli, S., Elliot, C.: Design de embalagem: 100 fundamentos de projeto e aplicação. Tradução de Renato Vizioli. Edgard Blücher, São Paulo (2011)
4. Twede, D.; Goddard, R.: Materiais para Embalagens. Coleção Quattor **1–5**, 1–17. Editora Edgard Blücher Ltda, São Paulo (2010)
5. Braida, F., Nojima, V.L.: Tríades do design: um olhar semiótico sobre forma, o significado e a função. Rio Books, Rio de Janeiro (2014)
6. Ching, F.: Arquitetura, forma, espaço e ordem. Martins Fonte, São Paulo (2005)
7. Lefebvre, H.: O direito à Cidade. Centauro, São Paulo (2004)
8. Neto, E. S.: A Geometria Espacial nas Emabalagens de Produtos. pp. 1–18 (2005), https://www.google.com.br/#q=a+geometria+espacial+nas+embalagens+de+produtos*+elisi%Alrio+dos+santos+neto
9. Bueno, C., Alfabetização Matemática: Manifestações de Estudantes do Primeiro Ciclo sobre Geometria. Curitiba, 2009, pp. 23–24. Dissertação (Mestrado em Educação). Universidade Federal do Paraná (2009) http://www.ppge.ufpr.br/teses/teses/M09_bueno.pdf
10. Loureiro, M.A.: A estratégia do Cubo: Trisecção. In: Iº Congresso Internacional de En-genharia Gráfica, Desenho e Artes. Graphica 96. UFSC—Universidade Federal de Santa Catarina, vol. 1, pp. 491–500, Florianópolis, Santa Catarina (1996)
11. Fonseca, M.C.F.R., et al.: O ensino da Geometria na escola fundamental—três questões para a formação do professor dos ciclos iniciais, p. 2. Belo Horizonte, Autêntica (2005)
12. Barison, M. B. et al: Malhas Planas Poligonais em Desenho Geométrico: Geométrica. Londrina, Paraná. vol. 1, n 12a, pp. 1–11 (2005), http://www.uel.br/cce/mat/geometrica/php/pdf/dg_malhas.pdf
13. Morais, M., Santos, L.C.M., Pinha, S.A.M.: A Leitura da Gramática da Forma do Conjun to Habitacional da CDHU em Campinas. Gestão e Tecnologia de Projetos **9**(2), 23–36, jul/ dez. São Paulo (2014), http://dx.doi.org/10.11606/gtp.v9i1.74345
14. Celani, G.: Generative design in architecture: history and applications. In: International Architecture Conference New Strategies, Contempory Techniques, n. 13. Proceedings. Esarq UIC. Barcelona (2008)
15. Celani, G. et al.: A Gramática da Forma como Metodologia de Análise e Síntese em Arquitetura. In: Conexão—Comunicação e Cultura, 2007, **5**(10), 181–197. Anais de Conexão, Caxias do Sul, RS (2006)
16. Gips, J.: Computer implementation of shape grammars. In: Workshop on Shape Computation, pp. 1–11 (1999) http://www.shapegrammar.org/implement.pdf
17. Knight, T; Stiny, G.: Classical and non classical computation. information technology. **5**(4), 335–372, Cambridge (2001) https://www.andrew.cmu.edu/course/48-747/subFrames/readings/Knight&Stiny.classicalAndNonClassicalComputation.pdf

18. Brandão, B.: Design, biomimetismo e inovação. Design ao Vivo: biomimética (2013), http://www.ibqp.org.br/upload/tiny_mce/29-10-13_-_Dialogos_Inovadores_Bernadete_Brandao.pdf
19. Costa, D.S., Junior, M.B.: Proporções harmônicas nas embalagens de comercialização. In: Congresso de Pesquisa e Desenvolvimento de Design, **9**, 1–5. P & D, São Paulo. São Paulo (2010), http://blogs.anhembi.br/congressodesign/anais/index.php?s=proporções+harmônicas+nas+embalagens
20. Ramos, E.M.; Ramos, M. N. L.: Formas Geométricas Versus Orgânicas. In: XIV Congresso Internacional de Ingenieria Grafica, Ingraf. Jun., Santander, Espãna (2002)

Transformational Leadership: A Leap Towards NPD Team's Effectiveness

Syeda Asiya Zenab Kazmi, Marja Naaranoja, Juha Kytölä and Jussi Kantola

Abstract Transformational leadership has been the center of interest for organizational behavior theorists and management experts due to this leadership style's significance and appeal with reference to organizational team performance, effectiveness as well as innovativeness. In addition, new product development is considered the core operation of each and every industrial concern. The success of new product development related operations are becoming more challenging in today's' turbulent economic conditions. Hence, the current study is an attempt to explore the inter-connection between transformational leadership and new product development team's effectiveness to support organizational innovation. The empirical study was conducted based on the implementation of especially devised and validated quantitative and qualitative tools. The study sample represented the new product development team's working at three different global locations of an energy sector company. The data obtained through the mixed mode survey tools was analyzed statistically and qualitatively by implementing statistical methods. The research outcomes revealed that the dimensions of management initiatives (innovation variable), collaboration (NPD team effectiveness variable), communication (NPD team effectiveness variable) and affiliation with leader (transformational leadership variable) have positive association among each other while product innovation (innovation variable), communication (NPD team effectiveness variable) and leader's competence to empower its team (transformational leadership variable) have shown negative internal association.

Keywords Transformational leadership · Team effectiveness · New product development · Organizational behavior · Innovation

S.A.Z. Kazmi (✉) · M. Naaranoja · J. Kytölä · J. Kantola
University of Vaasa, 65101 Vaasa, Finland
e-mail: akazm@uva.fi

M. Naaranoja
e-mail: marja.naaranoja@uva.fi

J. Kytölä
e-mail: juha.kytola@uva.fi

J. Kantola
e-mail: Jussi.Kantola@uva.fi

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1 Introduction

In a real life scenario, we see only a few organizations, among the very many taking the lead through their innovative products or services, or their ways of working. Though they face the same external pressures and opportunities as compared to the other similar establishments. This confirms that they have something really distinctive within them to justify the uniqueness. An organization's internal strategic potential, in addition to specific external factors, is considered most vital in determining an organization's innovative capability to sustain, develop and grow on the basis of its innovative product ideas, services or introduction of new work processes. Professional inadequacies namely; poor planning and financial judgement, greatly hamper the process of new product idea generation capability of an organization [1] (Barber et al. 1989). Nooteboom [2] suggests that factors like insufficient delegation, the high turnover of managerial staff, as well as managerial deficiencies also affect negatively. Product or service development as considered a core function of any business organization. According to [3] Oakey (1991), excessive dependence on word-of-mouth sales without any real and well-coordinated marketing efforts are the causes of professional inadequacies. This further hinders the process of a new idea generation sometimes linked to an overall new product or service generation or a unique idea related to the organization's working process. NPD performances are associated with the organization's operational effectiveness. Understanding the organization context, the industry dynamics and developing the product development teams' skill sets and capabilities are of paramount significance in order to drive the product innovation process toward success. Therefore, finding one optimal way is the hallmark of the right organizational leadership through its strategic work team building capability.

In this context, the current study begins by a literature review of transformational leadership style, NPD team's effectiveness and organizational innovativeness, then will proceed to formulate the study hypotheses. The focus on research methodology and research model will be discussed at the second section. The analyses of study findings and recommendation will be provided for managers and management research at the end of this research paper.

2 Conceptual Roots of New Product Idea Generation and Effective Communication

2.1 Transformational Leadership

Burns [4], a distinguished leadership scholar, a historian and a political scientist was the first to present the concept of transformational leadership. He has carved out the clear distinction between transactional and transformational leadership. This leadership style is regarded a strong source to stimulate the process of thought

(involving beliefs and values) as well as the cognitive behavior (based on attitudes and attributes) of the followers [5].

According to Bass and Avolio [5], transformational leadership is considered a strong source for work team's capacity building to enable high performance levels. This can be achieved through the four elements of transformational leadership, namely intellectual stimulation, individualized consideration, inspirational motivation and idealized influence. In simple words, this style of leadership necessitates leader's capabilities [6, 7] to foster leadership potential in others [8]. Transformational leadership helps in enhancement of the motivation level, morale, and job performance of followers through a variety of ways, for example, getting connected with the follower's sense of identity as well as the overall identity of the organization; to inspire the team member by being a role model and raise their interest in the project; develop the team members or the followers competent enough to take utmost responsibility of their assigned tasks and understand their weaknesses and strengths.

Transformational leadership is characterized as a leader's ability to articulate a shared vision of future, intellectually stimulate employees, and attend to individual differences in the work force [9]. Transformational leaders [10] filled with self-awareness in addition to intense personal humanistic attributes such as creativity and flexibility display a strong ability to inspire others. The four elements of transformational leadership is defined in the next paragraph.

The term 'idealized influence' refers to the leader's capacity to lead his or her followers by setting examples [11] based on high moral and ethical grounds [12–15]. 'Individualized consideration' refers to the leader's ability to achieve his or her followers' maximum potential through coaching or mentoring, during a process of helping and refining their skill potential. 'Inspirational motivation' refers to the leader's ability to develop a desire in their followers for a cause. 'Intellectual stimulation' refers to the leader's aptitude to encourage his or her team members or followers to think and generate new ideas [11, 16, 17].

Hence, transformational leadership [18–20] is considered a preferred style by organizational management, theorists and researchers, who truly want to encourage [11] and develop their employee's skill sets to perform beyond expectations. According to [21] transformational leadership supports organizational learning by facilitating intellectual stimulation, inspirational motivation, and self-confidence among organization members. According to the research study findings by Pearce and Sims [22] "shared or collective leadership is considered as one of the most significant basis of team effectiveness". The case findings further revealed obvious relevance between the components of strategic leadership among team members. Hence, this relationship is likely to substantially enrich team effectiveness. In the next section we will discuss the concept of 'NPD team's effectiveness' in the light of related theories.

2.2 NPD Team Effectiveness

Successful teams gain strength when their members collaborate with each other on the basis of defined and acceptable goals [23]. According to Pearce and Sims [22] "shared or collective leadership is considered the most significant basis of team effectiveness". The case findings revealed obvious relevance between the components of strategic leadership among team members and this relationship is likely to substantially enrich team effectiveness. A study by Pearce and Sims [22] confirmed positive linkage between transformational leadership and the provision of vision, inspiration, expressive idealism and team empowerment [11]. Strong motivational appeal can be developed among team members through leadership for the fulfilment of collective team objectives and goals.

Motivation is the combination of a person's desire and energy directed towards achieving one's goals. According to Kouzes and Posner [24], one of the main characteristics of exemplary leaders is to empower others to act [25] and management leaders or organizations can adopt team empowerment practices to distribute power and authority downstream and develop canters or mid-points of innovation and excellence at all levels of the organization influencing people's motivation enables followers to do what they want to do know must be done [26]. Neither financial gains nor strategy and not even technology but it is simply teamwork what is actually the ultimate source of competitive advantage since it is dominant and so exceptional [27]. The significance of work teams gaining strength since the jobs are getting bigger with the advent of complexed organizational structures as well as the dynamic scope of multi-national [1]. Furthermore, an optimal maintenance strategy mix is crucial for enhancing the availability and reliability levels of production conveniences without significantly increasing operational costs [27]. In the industrial scenarios, cross-functional product development teams (CFPDTs) are defined as groups of individuals selected from various functional specialties or departments and are combined together for the common purpose of creating and refining new products [28]. Team leaders can apply considerable influence on their NPD team's learning and knowledge application, and are also capable of explaining a significant proportion of the variance therein [29]. An effective leadership style can identify, engage and effectively utilize cross functional teams; develop, manage and then strike a balance among the various inconsistent factors being created while the innovation process passes through strategic controls to ensure success [11, 30–34].

According to surveys conducted in 1997, new products introduced during the period of 5 years from 1992 to 1997, contributed as much as 50 % of the total revenues and profits, though at the same time, the new product failure rate remained high [35]. There a number of companies that struggle while deciding for `innovation` since it is a complex process that requires constant control and balancing amongst various contrasting factors, namely short term versus long term plans and

related issues while accommodating the internal customers (i.e. employees) as well as satisfying the company's external customers and other stakeholders. Hence, while pursuing both ends simultaneously poses conflicting demands upon the organizational structure and (inter) actions for innovation in which R&D projects are being embedded [35].

The need to generate new ideas is very critical to firms that want to satisfy their customers' demands effectively and efficiently by offering desired and required products to achieve considerable competitive advantage [36]. Woodruff [37] supports the notion by suggesting that in order to succeed, organizations must re-orient their strategies well in time towards superior customer value. According to Edgett and Parkinson [38], real time market research plays a significant role in identifying customer needs and behavior patterns in relation to their choice in addition to offering insights into generating new product ideas with the a prospect of catching the attention and satisfying the demand of a diverse set of users. In addition, Dougherty and Heller [39] suggest that when product innovators do not understand their customer needs, they usually end up developing seriously flawed products and services. The process of new idea generation is related to the creation of new products, services and processes that requires a set of skills and knowledge base as diverse as in routine manufacturing. Therefore, the potential of an organization's new idea generation capability depends critically on the eminence of an organization's learning ability.

3 Research Methodology

In this survey we intend to identify the direction of association among the selected study areas namely; transformational leadership, work team's effectiveness and organizational innovation process. To test the propositions, a field survey using quantitative questionnaire was conducted. The selected quantitative approach is the survey methodology which was performed through an email based questionnaire having 50 items. To obtain feedback on the selected study areas (transformational leadership, work team's effectiveness and organizational innovation) each area was further divided into variables to explore the direction of association among them. The said variables, with the help of their specific indicators, were then evaluated on the basis of closed-ended questions from a quantitative Likert scale. In the current survey project, a 5-point Likert scale, with opinion choices of 'strongly disagree', 'disagree', 'neither agree', 'nor disagree', 'agree' and 'strongly agree', has been used through online questionnaire distribution. Scales 1 and 2 correspond to the respondent's level of disagreement, 3 equals a neutral answer and in the same way 4 and 5 show the respondent's degree of agreement to the posed statement or question.

3.1 Development of Hypotheses

In the light of the literature review, it is discussed that transformational leadership style strengthens work team's effectiveness to harness organizational innovative process and proposes the following hypotheses:

- H1: "Management initiatives" (NPD idea support) has significant degree of association with "Collaboration".
- H2: "Product innovativeness" (NPD idea support) is significantly linked to organizational "Communication" (NPD idea support).
- H3: "Leader's competence" to empower followers (transformational leadership) is significantly linked to "Product innovativeness".
- H4: The variable "Management initiatives" (NPD idea support) is significantly linked to the team's sense of "Affiliation with leader" (Transformational leadership- Idealized influence).
- H5: The variable "Management initiatives" (NPD idea support) is significantly linked to organizational "Communication" (NPD idea support and NPD team climate)

3.2 Sample and Data Collection

The case study was conducted on 30 survey recipients from three international work locations, i.e. 10 participants from each selected location; Finland, the UK and Norway. The participants were representing five categories in accordance with their affiliation with the work roles or categories (i.e. i-general management, ii-design, iii-project management (R&D), iv-technical engineering and v-product development and sales). Data obtained from the survey recipients through 30 questionnaires were analyzed statistically and five proposed relations were tested through correlation and regression analyses.

4 Results and Analysis

In research literature new product development (NPD) idea support or innovation refers to the desirable characteristics of team leaders and members who are involved in new product development operations. We have distributed the conceptual inventory items into two separate categories i.e. NPD idea support or innovation and NPD team climate [40]. In our survey, this concept refers to an organization's capacity to offer supportive practices to its work teams, involved in organizational innovative operations. This results in connecting the industry with its customers by

making them their integral part in the entire NPD process; scoping, product definition, development, validation, and beyond. The selected indicators seek feedback to reveal organizational practices in relation to new product development idea generation team potential. In total, twenty six questions were designed/modified while following the strategic thinking characteristic introduced by Sun, Xu, Shang [40] in their research inventory. Furthermore, in our survey, the concept of transformational leadership refers to the organization's capacity to offer its work teams a supportive leadership [5, 41] environment to harness new product development idea generation. The selected indicators seek feedback to reveal organizational practices with reference to transformational leadership connected to new product development idea generation team potential. In total, eight questions were designed/modified while following the transformational leadership characteristic introduced by Bass and Avolio [5, 41] in their research inventory. Cronbach's alpha internal consistency indicator was applied to assess the reliability of the construct variables included in the survey tool [42]. All the construct items linked to organizational innovative initiatives and work teams effectiveness were found reliable and acceptable with Cronbach alpha values over 0.7. Therefore, all the construct items maintain good internal consistency and must be retained. Similarly, all the construct items related to transformational leadership were found reliable and acceptable by having alpha values over 0.67. Hence, all the referred construct items must be retained.

In this study, correlation analysis was conducted to test the hypotheses and to define the direction of relations. According to the study results the correlation calculated to assess the relationship between the variables i.e. 'management initiatives' (NPD idea support/innovation) and 'collaboration' (NPD team climate) yielded R value of 0.4294, thus, technically proving a positive but weak correlation between the two study variables. In addition, the value of R2, the coefficient of determination, is 0.1844. The P-Value calculated on the basis of R value is 0.017884 and is significant at $p < 0.05$. Therefore, the study hypothesis-1, saying that 'the variable "management initiatives" (NPD idea support/innovation) is significantly linked to "collaboration" (NPD team climate) is accepted.

Furthermore, the correlation calculation to assess the relationship between the two study variables (i.e. product innovativeness (NPD idea support/innovation) and communication (NPD team climate) yielded the R value of 0.1214, therefore proving a weak but positive correlation. Moreover, the value of R2, referred as coefficient of determination, is 0.0147. The P-Value calculated on the basis of R value is 0.522789 and is not significant at $p < 0.05$. This further proved the study hypothesis -2 as not accepted. Correlation coefficient for the relationship between two study variables (i.e. leader's competence to empower (transformational leadership) and product innovativeness (NPD idea support) yielded the R value of 0.1696, and therefore technically proving a weak but positive association. The value of R2, the coefficient

of determination, is 0.0288. The P-Value calculated on the basis of R value is 0.370263 and is not significant at $p < 0.05$. Hence, the study hypothesis-3, saying that "Leader's competence to empower" (transformational leadership) is significantly linked to "product innovativeness" (NPD idea support) is not accepted.

In addition, the correlation calculated to view the relationship between the two study variables (i.e. management initiatives (NPD idea support) and affiliation with leader (transformational leadership- idealized influence) yielded the R value of 0.508 and technically proving a weak but positive correlation. Furthermore, the value of R2, the coefficient of determination here, is 0.2581. The P-value calculated on the basis of R value is 0.004158 and significant at $p < 0.05$. Therefore, the study hypothesis-4, saying that "management initiatives" (NPD idea support) is significantly linked to team's sense of "affiliation with leader" (transformational leadership) is accepted.

The correlation analysis to evaluate the relationship between the two study variables (i.e. management initiatives-NPD idea support) and communication—NPD idea support and NPD team climate) yielded the R value of 0.3261, and proving a positive correlation between the two. The value of R2 here is 0.1063. The P-Value calculated on the basis of R value is 0.078635 proving that the result is significant at $p < 0.01$. Therefore, the study hypothesis-5, saying that the variable "Management initiatives" (NPD idea support/innovation) is significantly linked to organizational "communication" (NPD team climate) is accepted.

In accordance with the correlation analyses results displayed in Table 1, study's research process representation is being designed and displayed in Fig. 1.

Figure 1 displays study outcomes in a summarized form. Hypothesis 1, 4 and 5 are accepted while hypothesis 2 and 3 are not accepted. The accepted hypothesis are identified through grey colored boxes while the two red boxes are showing the ones which are not accepted.

Table 1 Coefficient correlation analysis results on degree of association linked to study variables

Correlation coefficient	Variables	R value	R2 value	P value calculated at R	Significance at $p < 0.05$
1H	Management initiatives	0.429	0.184	0.017	Significant
	Collaboration				
2H	Product innovativeness	0.121	0.014	0.522	Not significant
	Communication				
3H	Leader's competence to empower	0.169	0.028	0.370	Not significant
	Product innovativeness				
4H	Management initiatives	0.508	0.258	0.004	Significant
	Affiliation with leader				
5H	Management initiatives	0.326	0.106	0.078	Significant
	Communication				

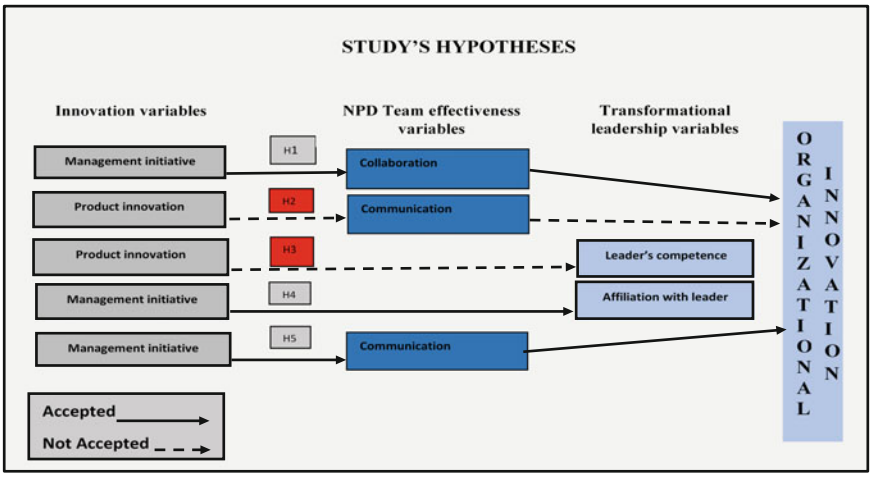


Fig. 1 Study's research process representation

5 Conclusion

This survey, which is conducted on three international locations of an energy sector multinational company highlighted the degree of association among the variables taken from transformational leadership style, NPD team's effectiveness and NPD idea support or innovation. Two important findings of the current study were that the process of product innovativeness is not effectively supported through the elements of effective organizational communication and the Leader's competence to empower followers. While, management initiatives supported through communication, collaboration and strong affiliation with leader proved effective.

Hence, hypotheses 1, 4 and 5 of the study are supported while and hypotheses 3 and 4 are not supported. It reflects that there is enough room for improvement in the areas of organizational leadership practices to support new product innovation process in the light of theories and studies conducted in the study fields [5, 41, 43–53].

However, the survey has its own limitations (e.g., its focus mainly on three European industrial sites and dealing with small sample size etc.), hence the current study findings cannot be fully adaptable by the other organizations. However, this study opens options for future research by management researchers to investigate in-depth the role of new product development team dynamics, its linkage with management initiatives and effective communication to supporting the innovation process.

References

1. Naquin, C.E., Tynan Barber, J., Metcalfe, J., Porteous, M.: Barriers to growth: the ACARD study. In: Barber, J., Metcalfe, J., Porteous, M. (eds.) Barriers to Growth in Small Firms. Routledge, London (1989)
2. Nooteboom, B.: Innovation and diffusion in small firms: Theory and evidence. Small Bus. Econ. **6**, 327–347 (1994)
3. Oelkers, G., Elsey, B.: The Strategic Magnifier—A Cognitive Tool for Strategic Thinking Problems and Perspectives in Management, 3, pp. 196–209 (2004)
4. Burns, J.M.: Leadership. Harper and Row, Newyork (1978)
5. Bass, B.M., Avolio, B.J.: The implications of transactional and transformational leadership for individual, team, and organizational development. Res. Organ. Change Dev. **4**, 231–272 (1990)
6. De Cremer, D., van Knippenberg, D.: Leader self-sacrifice and leadership effectiveness: The moderating role of leader self-confidence. Organ. Behav. Hum. Decis. Process. **95**, 140–155 (2004)
7. Van looy, B., Debackere, K.: Using Time and (Social) Space When Trying to Innovate; Acknowledging the Nature of Knowledge Creation Processes working paper. DTEW.KU Leuven, Belgium (2002)
8. Bass, B.M., Avolio, B.J.: Transformational leadership: a response to critiques. In: Chemers, M.M., Ayman, R. (eds.) Leadership Theory and Research: Perspectives And Directions, pp. 49–80. Academic Press, San Diego, CA (1993)
9. Bass, B.M.: Leadership and Performance Beyond Expectations. Free Press, New York (1985)
10. Hurley, J., Linsley, P.: Leadership challenges to move nurses toward collaborative individualism within a neo-corporate bureaucratic environment. J. Nurs. Manag. **15**(7), 749–755 (2007)
11. Bono, J.E., Judge, T.A.: Self-concordance at work: toward understanding the motivational effects of transformational leaders. Acad. Manag. J. **46**, 554–571 (2003)
12. Podsakoff, P.M., MacKenzie, S.B., Bommer, W.H.: Transformational leader behaviors and substitutes for leadership as determinants of employee satisfaction, commitment, trust, and organizational citizen. J. Manag. **22**(2), 259–298 (1996)
13. Whitener, E.M.: The impact of human resource activities on employee trust. Hum. Res. Manag. Rev. **7**, 389–404 (1997)
14. Bass, B.M., Steidlmeier, P.: Ethics, character, and authentic transformational leadership behavior. Leadersh. Q. **10**(2), 181–217 (1999)
15. Dirks, K.T., Ferrin, D.L.: Trust in leadership: Meta-analytic findings and implications for research and practice. J. Appl. Psychol. **87**, 611–628 (2002)
16. Jung, D.I., Avolio, B.J.: Effects of leadership style and followers' cultural orientation on performance in group and individual task conditions. Acad. Manag. J. **42**, 208–218 (1999)
17. Kirkpatrick, S.A., Locke, E.A.: Direct and indirect effects of three core charismatic leadership components on performance and attitudes. J. Appl. Psychol. **81**, 36–55 (1996)
18. Bass, B.M.: Leadership and Performance Beyond Expectations. Free Press, New York (1985)
19. Kazmi, S.A.Z., Naaranoja, M., Takala, J.: Diverse workforce supported through transformational leadership ensures higher operational responsiveness. Global Bus. Rev. **2** (4) (Print ISSN: 2010-4804, E-periodical: 2251-2888) (2013) doi:10.5176/2010-4804_2.4.253
20. Taylor, C.M.: Transformational leadership in a nonprofit organization: a Case study of a Filipino nonprofit in diverse communities. Doctoral dissertation, Temple University) (2014)
21. Coad, A.F., Berry, A.J.: Transformational leadership and learning orientation. Leadersh. Organ. Dev. J. **19**(3), 164 (1998)
22. Pearce, C.L., Sims, H.P.: Vertical versus shared leadership as predictors of the effectiveness of change management teams: an examination of aversive, directive, transactional, transformational, and empowering leader behaviors. Group Dyn. Theory Res. Pract. **6**(2), 172–197 (2002)

23. Meuse, K.P.: A comparative analysis of the Korn/Ferry T7 model with other popular team models, driving team effectiveness. The Korn/Ferry Institute, Los Angeles (2009)
24. Kouzes, J.M., Posner, B.Z.: Exemplary Leadership. Jossey-Bass Publishers, San Francisco, CA (2003). Hill, T., Westbrook, R.: SWOT analysis: it's time for a product recall. Long Range Plan **30**(1), 46–52 (1997)
25. Childre, D., Cryer, B.: From chaos to coherence (The Power to Change Performance). Heartmath Llc. Publishing, USA. p 309, ISBN-13: 978-1879052468 (2000)
26. Mengue, B., Auh, S., Shih, E.: Transformational leadership and market orientation: implications for the implementation of competitive strategies and business unit performance. Elsevier, Science direct. J. Bus. Res. **60**(2007), 314–321. Ref. Military Leadership (1993). FM 22-100. W. H. Freeman, San Francisco, CA (2007)
27. Lencioni, P.: The Five Dysfunctions of a Team: A Leadership Fable. Jossey-Bass, San Francisco (2002)
28. Ulrich, K.T., Eppinger, S.D.: Product Design and Development. McGraw-Hill, New York (1995)
29. Sarin, S., McDermott, C.: The Effect of Team Leader Characteristics on Learning, Knowledge Application, and Performance of Cross-Functional New Product Development Teams. Decis. Sci. **34**(4), 707–739 (2003)
30. Howell, J.M., Avolio, B.J.: The Ethics of Charismatic Leadership: Submission or Liberation. Acad. Manag. Executive **6**, 43–54 (1992)
31. O'Connor, J., Mumford, M., Clifton, T., Gessner, T., Connelly, M.: Charismatic leaders and destructiveness: a historiometric study. Leadersh. Q. **6**, 529–555 (1995)
32. Gardner, W.L., Avolio, B.J.: The charismatic relationship: a dramaturgical perspective. Acad. Manag. Rev. **23**(1), 32–58 (1998)
33. Conger, J.A., Kanungo, R.N.: Charismatic Leadership in Organizations. Sage, Thousand Oaks, CA (1998)
34. Conger, J.A., Kanungo, R.N., Menon, S.T.: Charismatic Leadership and Follower Effects. J. Organ. Behav. **21**, 747–767 (2000)
35. Ottum, B.D., Moore, W.L.: The role of market information in new product success/failure. J. Prod. Innov. Manage **14**, 258–273 (1997)
36. Wheelwright, S.C., Clark, K.B.: Revolutionizing Product Development—Quantum Leaps in Speed, Efficiency, and Quality. The Free Press Inc., New York, NY (1992)
37. Woodruff, R.B.: Customer value: the next source of competitive advantage (1997)
38. Edgett, S., Parkinson, S.: The development of new financial services. Identifying determinants of success and failure. Int. J. Serv. Ind. Manag. **5**(4), 24–38 (1994)
39. Dougherty, D., Heller, T.: The illegitimacy of successful new products in large firms. Organ. Sci. **5**, 200–218 (1994)
40. Sun, W., Xu, A., Shang, Y.: Transformational leadership, team climate, and team performance within the NPD team: Evidence from China. Asia Pacific J. Manag. (2012). doi:10.1007/s10490-012-9327-3
41. Bass, B.M., Avolio, B.J.: Transformational leadership: A response to critiques. In: Chemers, M.M., Ayman, R. (eds.) Leadership Theory and Research: Perspectives and Directions, pp. 49–80. Academic Press, San Diego, CA (1993)
42. Cronbach, L.J.: Coefficient alpha and the internal structure of tests. Psychometrika **16**(3), 297–334 (1951)
43. Kazmi, S.A., Naaranoja, M.: Comparative approaches of key change management models—a fine assortment to pick from as per situational needs! In: Presented in the 3rd Annual International Conference(s) organized by Business Strategy and Organizational Behavior (BizStrategy 2013), Print ISSN: 2251-1970, E-Periodical ISSN: 2251-1989 (2013a) doi:10.5176/2251-1970_BizStrategy13.41
44. Kazmi, S.A., Naaranoja, M.: Connecting individual differences in workforce to organizational creativity through transformational leadership for corporate transformational effectiveness. Open J. Leadership **2**(4), 73–77 (2013b). doi:10.4236/ojl.2013.24010

45. Kazmi, S.A.: Conquering environmental inconsistencies during the New Product Development (NPD) activity lead to corporate sustainable success`. Proceedings of the 3rd International Conference on Industrial Engineering and Operational Management (Ieom-2012), July 3-6, pp. 2552–2559. Istanbul, Turkey (2012)
46. Kazmi, S.A.Z., Kinnunen, T.: Deep leadership coaching effectiveness in a corporate scenario, constitutes proactive leadership solution for `Optimal Team formation. Eur. J. Soc. Sci. (EJSS) **31**(2), 166–189, ISSN: 1450-2267 (2012)
47. Kazmi, S.A., Naarananoja, M., Kytola, J.: Harnessing new product development processes through strategic thinking initiatives. Int. J. Strat. Decis. Sci. (IJSDS) **6**(3), 28–48 (2015). doi:10.4018/ijsds.2015070103
48. Kazmi, S.A., Naaranoja, M.: Cultivating strategic thinking in organizational leaders by designing supportive work environment! Procedia Soc. Behav. Sci. **181**, 43–52 (2015a). doi:10.1016/j.sbspro.2015.04.864
49. Kazmi, S.A., Naaranoja, M.: Fusion of strengths: t-style thinkers are the soul savers for organizational innovative drives and the allied change processes. Procedia Soc. Behav. Sci. **181**, 276–285 (2015). doi:10.1016/j.sbspro.2015.04.889
50. Kazmi, S.A., Naaranoja, M.: Innovative drives get fuel from transformational leadership's pied pipers' effect for effective organizational transformation! Procedia Soc. Behav. Sci. **181**, 53–61 (2015c) doi:10.1016/j.sbspro.2015.04.865
51. Kazmi, S.A., Takala, J.: Aiming for effective industrial operational management through transformational leadership—quest for the best fit as an optimal team! In: Proceedings of the 10th International Conference of the Academy of HRD (Asia Chapter), held on December 3–6, 2011 in Kuala Lumpur, Malaysia. ISBN: 978-967-960312-5
52. Kazmi, S.A., Takala, J.: Individual differences in work force substantiate greater levels of operational responsiveness through transformational leadership. In: International Conference on Business Strategy and Organizational Behavior (BizStrategy). Bali, Indonesia. pp. 50–55 (2012a)
53. Kazmi, S.A., Takala, J.: Entrenching strategic competitive advantage through transformational leadership! In: 3rd International Conference on Industrial Engineering and Operations Management. Istanbul, Turkey. pp. 2517–2526 (2012b)

Protecting Design: Leveraging Design for Robust Content and Knowledge Transfer into Patents

Robert Watters and David Craib

Abstract A key focus of this literature review is to assess whether the current practice for information transfer between design and patent agent is sufficient to result in the prosecution of patents that draw from the full design development process. The prevalence, purpose and growth of patenting is identified. The nature of design development with the production of many concepts prior to the commercialization of a single direction is reviewed. The building blocks of a patent and how the inventive content is assessed is also reviewed. Current methodology for exchanging information between design development and patent agent is considered. The authors recommend further study and consideration of the transfer of knowledge between designers and patent agents for the purpose of creating valuable patents and protecting design innovation efforts.

Keywords Design development · Knowledge transfer · Patent disclosure · Valuable patents · Innovation

1 Introduction

With increasing frequency companies are filing for intellectual property (IP) patents and "The burgeoning numbers of patents awarded point to the growing strategic importance of patenting" [9]. They hope that filing IP will eventually secure them a granted patent and a monopoly in the market for their innovative product.

Inventors, or their representatives, generate patent applications containing information that describes their inventions. Arriving at a granted patent includes an active prosecution between the inventors and the patent issuing body where patent examiners actively challenge the application's claims of invention and regularly issue rejections. In response, the inventor tries to submit adjustments to remove the rejections. The inventor's response, however, is limited by the scope of the

R. Watters (✉) · D. Craib
School of Industrial Design, Carleton University, Ottawa, Canada
e-mail: RobertWatters@cmail.carleton.ca

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information originally describing the innovation. Therefore the content of the application is extremely important.

This literature review aims to uncover information about whether an effective transfer of information from the inventor designer to the patent practitioner exists. It reviews current information about the needs and the demands of patenting. It looks at the process of design development and how inventive concepts are created and selected. It reviews the tasks of the patent agent and the level of focus placed on the transfer of information from design to practitioner. Can the investment in design development be better protected through further understanding of this process? The primary author is an experienced industrial designer with more than fifteen granted patents in the area of physical products.

2 Patent Background Related to Design

The intellectual property space is growing. In 2003, within high income countries there were 1,276,800 applications pending and in 2013 this amount had increased to 1,548,900. The rate of increase was higher for all income countries combined during the same period [20]. Applying for patents is common and increasing.

Companies or individuals that invent or develop products for competitive sale in the market generally look for advantages over their competitors. It is well known that innovation is necessary for companies to stay ahead. Developing an advantage in the market takes time and resources and can require ongoing commitment. Innovators can be defined as firms with expenditures on research and development efforts, including industrial design, towards the introduction of new products or processes [2].

Companies or inventors that want a patent, file their innovation as a patent application. If they pass the tests applied by the patent examiner for patentability the inventors are granted the exclusive right to their discoveries and a temporary monopoly in the market. Granting exclusive rights to the inventor is intended to encourage the investment of time and resources into the development of new and useful discoveries. In exchange, the inventors provide the details of their inventions to the patent granting agency so that they can be viewed and understood by competitors and the public. Once the term of protection has ended, the patented innovation enters the public domain where anyone, including competitors, can make use of it [16].

3 Dynamics of Securing a Patent

The patent system's timing cycle is not entirely synchronous to that of the development process. Its timelines are long. In 2014 the average time to receive a granted patent for the USA was 27.4 months [17]. An application that is filed in one of

many patent offices around the world under the process that allows the inventors global protection is even longer. It might not be made visible to the public for 18 months after filing and not start active prosecution before 30 months or longer. The information in patent applications could be considered as dated at the time of the application's prosecution and companies should be aware of these cycles as they consider their filings. This means that companies frequently launch a product before they know if they have patent protection. In some cases new products that are introduced into the market around the time of the patent application filing, may no longer be in the market [12] when the patent is finally granted or rejected. In such a case is a patent still useful? This depends on the patent's focus. If the patent disclosure/content has been carefully considered to have a forward looking focus, it may be adjusted to cover the next generation product. Ideally a patent can protect a technology that will last for a long timeframe and still apply through successive generations of product.

Active patent prosecution involves targeted challenges directed against the application's specific claims of invention by the patent examiner. The examiner performs searches to ensure the requirements for non-obviousness, novelty, and utility. Examiners routinely find examples of similar inventive material available at an earlier date. This forms sufficient basis for rejection. As a rebuttal, the inventor may submit adjusted claims of invention that focus on a slightly different aspect of invention. Inventors hope that upon re-evaluation they are now considered novel and non-obvious and are accepted. This cycle can repeat itself for years until a patent is granted, the applicant abandons it or an absolute rejection is made. Importantly, the adjusted claims can only be considered if they have direct support from the inventive description included in the original application. Having a range of inventive material and detail outlined in the description is critical and allows for greater flexibility in adjusting for acceptable claims. Therefore having a range of content in the application is critical to its prosecution.

The World Intellectual Property Organization's Patent Drafting Manual warns of having too little information in the description [18]. This means that if information known about the invention is not included in the disclosure, the agent may be unable to counter an examiner's argument against novelty or obviousness since the necessary inventive elements were not disclosed and cannot be used in support of adjusted claims. "In drafting the detailed description section, the patent agent will generally want to err on the side of inclusion" [18], meaning that including more rather than less relevant material is preferable for the initial application. Additionally, it is common for the inventors to refile an exact copy of the application but with the purpose of gaining different, broader, claims of invention. This is called filing a continuation. This practice further extends prosecution into the future and adds further incentive to include forward-looking content into the original disclosure.

4 Patent Quality

Horstmann analyses models of patenting behaviour focusing on companies. His research addresses three stages in the innovation-patent cycle that include 1, the race to innovation, 2, the innovator deciding whether to patent, and 3, the form of the resulting monopoly, depending on whether the patent is applied for and granted. If the patent is granted, the innovator's competitor is deterred from imitating the patented product, resulting in a monopoly for the innovator [6]. The innovator must decide whether to patent their innovation while recognizing that the potential patent will have a limited amount of coverage. To what extent an individual patent covers the market is hard to determine [6] and will depend on specific factors.

The concept of "patent quality" is not well defined [5], yet the general concern for patent quality is logical as so much is invested in research and development. In some cases a reference to a high quality patent simply means that the patent meets the criteria for patentability with a low likelihood of being overturned in court on technical shortcomings. Other references to quality apply to the usefulness and utility of the invention. Another meaning—which is the main focus of this paper—is the quality of the written patent's content, and how it exceeds minimum standards to offer the patentee significant protection [5] and flexibility.

Guerrini proposes a methodology for increasing patent quality by applying business management and quality procedure framework as a system to determine and better understand a process for increasing the effectiveness of patents [5]. The broad aim is to draw attention to the definition of patent quality as an important subject of scholarly inquiry. More specifically, the aim is to address the meaning of patent quality, and ask if patents can be designed to maximize their utility and usefulness [5].

5 Product Development Generates Many Solutions

In the context of a patent, an inventor is a person that has generated an inventive aspect claimed in the patent application. The inventor may or may not own the business rights to the patent since patent ownership can be assigned to another person or company. When designers work for clients or an inventor they can easily become an inventor through the work that they do in further developing the initial idea for the client. "Designers consider their work to be a form of intellectual property. Often, our creations qualify for utility or design patents because they meet the necessary qualifications" [19].

To commercialize a solution, designers may be "producing any one of what might well be a large range of satisfactory solutions rather than attempting to generate the one hypothetically- optimum solution" [3] where only one might proceed to manufacture. In such a case, consideration and review of the full body of design work for inventive content may be helpful in creating what Allison calls a

more valuable patent [1]. In his book *Design Thinking*, Nigel Cross writes of observations where designers arrive at many concepts while considering a design problem. Even a relatively simple design task studied for a short duration, generated multiple concepts. From these, further concept refinement took place and then a final direction was selected from among them [1]. It makes sense that a concept, chosen from many concepts, has a good balance of features appropriate for its entry into the market, as design practitioners focus on making commercially successful decisions [21].

There are numerous reasons why a design, under one set of circumstances, may be viable but under other circumstances may not be. Krishnan and Ulrich outline how strategies for managing complexity can drive final product direction decisions. They place product development decisions into four categories; concept development, supply-chain design, product design, and production ramp-up and launch [8]. In their process, a design embodying a combination of innovations will be selected, and others, with different innovation combinations may not proceed. For example, a design may be abandoned due to a supply chain issue; yet, will this supply chain issue still exist over the long term of the patent application? Should the designs with rejected innovation combinations be considered for inventive material?

An integrated product design approach with multiple stakeholders involved in guiding product development can result in multiple concept or prototype directions. For example; marketing, industrial design and engineering functions can all contribute to defining the initial attributes. Where "firms should consider carrying multiple design concepts forward into customer-ready prototypes. The concepts to be carried forward may be chosen from a larger list of potential concepts on the basis of a checklist using the following considerations: attribute-based customer preferences, qualitative factors (e.g., aesthetics, ease of use), product architecture, and manufacturing cost" [14]. Multiple concepts are expressly developed with ongoing efforts to gather customer feedback as well as costing information to "support the choice of which concepts to winnow out so that the firm can narrow down its options to the one product it will eventually launch" [14].

Timing is critical to product development. Realizing a development solution and going through the development process takes time. Development decisions are often made based on the time it takes to complete various phases. Srinivasan compares the risk of running development phases in parallel to save time, versus allowing each phase to benefit from sequential learning that results from serial execution [14]. It is almost certain that a design process will produce a number of substantial product designs with inventive characteristics, yet, in the current design environment it is likely that designers will only bring a few, or even a single inventive direction forward as they near commercialization.

At the early stages of new product development design solutions are not so clearly defined and work performed on concepts are still to be defined in their details. These early solutions are often not codified [10] and they are only available to the design team. Codification strategies involve the transformation of tacit knowledge into explicit knowledge allowing it to enter into the organization flow of information [13].

6 The Current Form of Information Transfer

The majority of applicants employ a patent attorney or registered patent agent since prosecuting a patent is a complicated process. In the USA, patent attorneys have law degrees, they can prosecute patents at the United States Patent and Trademark Office, and are able to represent the applicant in litigation or infringement cases involving the patent. Registered patent agents can prosecute patents but not litigate [7]. Patent agents often have specific technical skills from training and practice in other fields that informs their work as a patent practitioner [4]. This paper uses the term patent practitioner to cover both. Filing a patent application requires extensive knowledge of patent law, claim construction and specification drafting knowledge, and office action response strategy, in order to prosecute patents with a patent examiner. Patents also need to be constructed so they hold up under litigation and infringement suits. Performing this job takes significant training and ability [7]. With more than thirty thousand patent attorneys and ten thousand patent agents there is certain to be many individual approaches towards transferring information from design inventor to patent practitioner [7].

A practical problem faces the patent practitioner at the outset of working with a patent applicant. There is a need to learn about the inventive material. In order to create a patent application the patent application typically includes the Background, Summary, Detailed Description and Drawings, Claims and Abstract components [18]. What is the invention about, what is novel and what does it do? Obtaining an invention disclosure from the inventor is critical and necessary to the process of patenting an invention. This transfer is often referred to as the inventor interview or an information audit. This is when the inventive material is discussed and handed off.

This is the transfer of information from a group that may be completing their long product development process, to a patent practitioner, who is beginning their process with an information audit. This is a communication between different disciplines. This is an interdisciplinary interaction where the consideration of a collaborative process could lead towards generating more valuable patents [4].

So, what is currently recommended for the interview process? The WIPO (World Intellectual Property Office) Patent Drafting Manual describes that one or two interviews are preferred but at minimum a live telephone conversation with the inventor should take place. An inventor disclosure document is another tool used and it is ideally provided to the patent practitioner ahead of any interview. The underlying goal from the patent practitioner's perspective is to gain a complete understanding of the invention and to establish that there is no undetermined disclosure information. When critical timelines are involved it is not uncommon for patent practitioners to work with the level of disclosure initially provided in order to meet the timing priority [18].

Practically speaking, a sketch or a prototype may present many clear ideas to a designer. To a designer, knowledge is generated and understood by viewing the

object or its representation [1]. This capability may be less intrinsic in a lawyer or a patent agent. The designer should not assume that the innovation is understood, or that all of its details or nuances are understood. Because they are visible to the designer does not necessarily mean that it was communicated to the practitioner. Features and functions that are innovative should be explicitly communicated. Often when the patent process is initiated, the design is near commercialization. The focus of the development team is on the innovation of the product for entry into to the market. But, it is likely that valuable and inventive concepts generated during the design process were still being considered shortly before this point [8]. How, and with what consistency, are these being considered and brought forward for discussion and exchange?

7 An Example of the Interview Reconsidered

There is some acknowledgment in the literature pointing to a need to re-consider this transfer. One example of a process improvement is outlined in *Reengineering the Inventor Interview*, which explores the format of the inventor interview. It notes that the typical interview results in an incomplete transfer of disclosure [15]. Numerous interviews were recorded and transcribed in the research. The researcher notes that the inventor and agent often have different ideas of what constitutes the invention. Most inventors tended to deliver a reasonably complete oral disclosure, but in a disconnected order [15].

The patent practitioner can have difficulty organizing and making notes that are complete and in clear and useable sentences, ready for later use [15] when they craft the disclosure and claims. This makes it difficult for the agent to fully recreate their initial understanding and generate a complete disclosure with well-considered claims of invention. Additionally the inventor's review of the agent's draft-level disclosure can be a difficult task for the inventor, since the capture in text format is different from the verbal description that the inventor made [15].

Through experimentation, a simple but useful system was evolved which simplified this process, reduced overall cost, improved the quality of the disclosure and the quality of the drafted claims [15]. The novelty of this process was to engage the inventor to draft the final claims during the inventor interview with the patent practitioner. Typically the claims were crafted only by the practitioner and only after the interview with the inventor. This new process yielded the inventive disclosure efficiently and ensured that the inventor and agent had a true understanding of the claims.

Toedt notes that the participant's' sense is that a higher quality application and claims result [15]. Additionally there is an improvement noted in cases where the patent agent has little knowledge of the area of innovation, since they were able to work closely on the claims, a critical component of the application, with the inventor.

8 Leveraging the Designer for Additional Patent Content

With the high number of applications at the patent offices there are concerns for backlogs and concern for how rigorous the review of each patent application is. This potential for reduced quality has prompted a move toward generating patent portfolios of multiple patents, where the collection is considered far more valuable that any individual patent. This quantity versus quality approach puts into question the value of the quality of any individual patent [11]. This patent portfolio approach is not definitive or easily applied by smaller companies [11] since multiple application costs more. We've seen that a patent prosecution lasts a few years. The patent application, at the point of filing should be considered for its longer-term utility and the designer and the design process should be leveraged to support this purpose.

Does the current design process ensure that all possible inventive material has been considered? Have the range of prototypes been documented, and have innovative aspects been tracked and are they ready for transfer to the patent practitioner? Is the designer thinking of all facets of the opportunity? Is the patent agent spending a significant amount of time extracting early concepts and understanding the parallel path prototypes that did not directly lead to commercialization? This level of information collection does not seem to be part of the current process of the designer or patent agent and this means that patents of lesser quality, and reduced long-term effectiveness, are being filed. This could result in a reduction of the long-term value of intellectual property protection with reduced competitive advantage and lead to less incentive towards research and development expenditure [6]. Can the designer be leveraged to bring forward beneficial information that can be successfully communicated to the patent practitioner and increase the value of the intellectual property?

9 Conclusion

Patent activity is at an all-time high. There are many product development approaches that can generate multiple concepts and prototypes. The information transfer between design development and the patent practitioner disciplines may not be as effective as it should be. It seems like the designer could be tasked with bringing more information forward in an organized and suitable format for time effective discussion, comprehension and exchange with the patent practitioner. Further work on these methods should be considered.

It seems that utilizing more innovation from the development process could improve the quality of the individual patent or form the basis for a patent portfolio. This approach may not require significantly increased resources, as the innovation has already been done through the design development process. Codification of design assets, while they are generated, may be useful to the development team and also provide increased accessibility of the information for the inventor interview.

Purposeful consideration and leveraging of the output of contemporary process-driven design and product development processes may result in additional useful inventive content into the patent disclosure. Designers, patent practitioners and their respective research bodies might want consider new research into untapped value in existing innovation efforts. Also, research into methods for more reliably transferring this higher fidelity information into patent applications may result in more robust and higher quality patents.

References

1. Allison, J.R., Lemley, M.A., Moore, K.A.: Valuable patents. SSRN Electron. J. (2003)
2. Cefis, E., Marsili, O.: Survivor: the role of innovation in firms' survival. Res. Policy **35**(5), 626–641 (2006)
3. Cross, N.: Designerly ways of knowing. Springer, London (2006)
4. Dykes, T.H., Rodgers, P.A., Smyth, M.: Towards a new disciplinary framework for contemporary creative design practice. CoDesign **5**(2), 99–116 (2009)
5. Guerrini, C.J.: Defining Patent Quality. 82 Fordham L. Rev. 3091, Chicago-Kent College of Law Research Paper No. 2013-38 (2014)
6. Horstmann, I., Macdonald, G.M., Slivinski, A.: Patents as information transfer mechanisms: to patent or (maybe) not to patent. J. Polit. Econ. **93**(5), 837 (1985)
7. Kirik, C.: Working with a patent practitioner, inventors eye **2**(1) http://www.uspto.gov/inventors/independent/eye/201101/advicepracticioner.jsp (2011)
8. Krishnan, V., Ulrich, K.T.: Product development decisions: a review of the literature. Manage. Sci. **47**(1), 1–21 (2001)
9. Lang, J.C.: Management of intellectual property rights. J. Intellect. Capital **2**(1), 8–26 (2001)
10. Manzini, R., Lazzarotti, V.: Intellectual property protection mechanisms in collaborative new product development. R&D Management (2015)
11. Parchomovsky, G., Wagner, R.P.: Patent Portfolios. University of Pennsylvania Law Rev. **154** (1) (2005)
12. Reitzig, M.: Improving patent valuations for management purposes—validating new indicators by analyzing application rationales. Res. Policy **33**(6), 939–957 (2004)
13. Schulz, M., Jobe, L.A.: Codification and tacitness as knowledge management strategies: an empirical exploration. J. High Technol. Manag. Res. **12**(1), 139–165 (2001)
14. Srinivasan, V., Lovejoy, W.S., Beach, D.: Integrated product design for marketability and manufacturing. J. Mark. Res. **34**(1), 154 (1997)
15. Toedt, D.C.: Reengineering the inventor interview. J. Pat. Trademark Off. Soc. **78**(19) (1996)
16. United States Patent and Trademark Office, http://www.uspto.gov/web/offices/ac/ido/oeip/patdesc.htm (2015)
17. United States Patent and Trademark Office, Fiscal Year 2014, Performance and Accountability Report, http://www.uspto.gov/about/stratplan/ar/USPTOFY2014PAR.pdf (2014)
18. WIPO Patent Drafting Manual: Geneva. World Intellectual Property Organization, Switzerland (2007)
19. Woodring, C.C.: A designer's view on the scope of intellectual property protection. AIPLA Q. J. **24**(2,3,4), 309 (1996)
20. World Intellectual Property Indicators 2014, http://www.wipo.int/export/sites/www/ipstats/en/wipi/2014/pdf/wipi_2014_patents.pdf (2014)
21. Zimmerman, J., Forlizzi, J.: Research through design. In: HCI. ways of knowing in HCI, pp 167–189 (2014)

Gender Bias in the Perception of Outstanding Leadership in the Maritime Industry

Bjørn Atahuallpa Bejar Fjærli, Salman Nazir and Kjell Ivar Øvergård

Abstract While female participation in work places has increased over the last decades, women only make up 1–2 % of the 1.25 million seafarers worldwide. The International Maritime Organization (IMO) and the International Labor Organizations are making a concerted effort to promote women into the maritime industry. Still, there are barriers in the maritime industry that hinder female employment, particularly in leadership positions. The primary aim of the paper is to investigate whether there is a significant difference in implicit beliefs about leadership between males and females. In addition to this, it seeks to evaluate whether the aforementioned difference is within the context of masculine versus neutral work domains. The findings indicated that employees in the maritime industry might have lower expectations towards female leaders thereby indicating the presence of gender bias in the evaluation of leaders.

Keywords Gender differences · Leadership · Maritime industry · Shifting standards · Role congruity

1 Introduction

Leadership and followership makes up a dynamic system. How followers perceive their leaders makes up an important part of the leader-follower relationship [1]. If only males are perceived to be suitable for leadership positions, the general

B.A.B. Fjærli · S. Nazir (✉) · K.I. Øvergård
Department of Maritime Technology and Innovation,
University College of South-East Norway, P.O. Box 235,
3603 Kongsberg, Norway
e-mail: salman.nazir@hbv.no

B.A.B. Fjærli
e-mail: bjorn.fjarli@hbv.no

K.I. Øvergård
e-mail: kjell.oevergaard@hbv.no

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potential for selecting the best leader is reduced [2]. Research have also shown that the standard for evaluating female leaders can be different from the standard for evaluating male leaders [3] and this can be subject to contextual variation [4]. Some studies have shown that female leaders are exposed to prejudice especially when they are working in an industry which is not congruent with female gender roles [5]. This have led to a tendency to underestimate females' competencies and skills that leads to women being evaluated as less competent that men despite having similar formal background [6]. The consequence is that women are excluded from academic positions [6], high-raking jobs [5], and receive less research funding [7]. These gender differences in evaluation of competencies and skills impairs women's access jobs, research funding and promotion to higher-ranked jobs. Gender difference in evaluation can also impact on female leaders' self-evaluation leading to women having a more negative self-perception of their own leadership skills than what is actually the case [2]. The effect of this is that fewer women may choose to not apply for jobs that require high qualifications because they believe that they are less qualified than they actually are.

Recently, the International Maritime Organization (IMO) and the International Labor Organizations strive to promote the integration of women into the maritime industry [8, 9]. Despite the fact that female participation in work life has increased over the last decades, the number of women working as seafarers only make up 1–2 % of the 1.25 million seafarers worldwide [10]. The maritime industry carries over 90 % of the world's goods, and they need to access the entire talent pool, regardless of gender [11]. Also, gender issues are not part of curriculum at maritime educational institutions, thus indicating a lack of awareness or strategy in how to ensure gender equality in the maritime domain [12]. Still, there are further barriers in the maritime industry that hinder female employment, particularly in leadership position. One study compared the self-evaluation of leadership skills of male and female maritime officers with a peer-assessment of these same leaders. Results showed that women tended to underestimate their good leadership skills while overestimating the level of their negative skills. Interestingly, the results for male officers showed exactly the opposite result. The consequence of this is that women overall will see themselves as worse leaders than they actually are. This means that the tendency for gender differences in evaluation also impact on the women themselves by changing their perception of their own skills [2].

The current paper aims to test whether gender plays a role in the evaluation process of identifying outstanding leaders. Following the focus of IMO to promote the participation of women in the maritime industry, we also investigate whether the Norwegian maritime industry have any particularities in their perception of female leaders that can hinder the access of females to maritime leadership positions.

1.1 Theoretical Framework

According to the Implicit Leadership Theory (ILT; [13]), the implicit expectations as well as assumptions of what a leader should be, are based on the cognitive representation of leadership. Moreover, the perception of an individual regarding how good or bad a leader may be, is derived from that person's implicit expectations and assumptions. Leadership traits vary from different societal cultures. It can also either be universally positive or negative [14–16]. The Implicit Leadership Theory indicated that implicit beliefs regarding leadership occur at an individual level. In the contrary, the Cultural Endorsed Leadership Theory (CLT) argues that implicit beliefs is a shared belief of individuals of the same cultural values [17]. From the CLT perspective, it suggests that cultural values may have an impact on how the maritime industry view leadership and thereby have one collective idea of what makes up an outstanding leader.

There are less female leaders than male leaders, especially in the maritime industry [11]. There are several explanations focusing on different aspects behind the trend. According to the role congruity theory [18], it argues that females do not have the same opportunities to contribute as leaders because of a perceived incongruity between the female gender role and the leadership role. Previous studies focused on the belief that the responsibility of being a female pose as an obstacle from achieving a leadership position (see e.g. [19]). Other studies suggested that male and female genders exhibit different personality traits, giving an indication that one gender is more suited for a specific occupational role over the other [20]. In addition, the male and female interpretations of their own leadership skills have been shown to be different—with the latter having the tendency to underestimate their own skills [2]. Likewise, the standard for evaluating a person is likely to be linked to stereotypical within-group expectations [21]. As discussed, it is more likely that there are different sets of evaluation standards based on gender employed by organizations when selecting potential leaders.

1.2 Hypotheses

Hypothesis 1 is stated as: *Participants will rate male leaders to be in need of higher average of leadership attributes than female leaders in order to be considered outstanding.*

Even though male and female leaders may be similar with regards to their leadership styles, there is often a difference in the way male and female leaders are perceived [2]. Women leaders may experience prejudice because of a believed incongruity with their gender role and the leadership role [18]. The gender of the leader may potentially set an unfavourable condition on how a particular leader is judged and evaluated. Thus it is interesting to investigate if the overall perception of an outstanding leader is affected by the leader's gender.

Hypothesis 2 is stated as: *Participants who belong to the maritime industry, as compared to the university student participants, will rate female leaders to be in need of lower average of leadership skills than its male counterparts to be seen as outstanding leaders.*

The maritime industry in general is a highly male dominated industry and that majority of the females who work at sea are within tourism-related transportation [22] The availability heuristic indicating that seafarers often are "seamen" might be inhibiting for women, and in particular women leaders, to choose and work at sea. Life at sea is argued to be very masculine—both in nature and culturally [11, 23]. Furthermore, women only make up a humble minority of 1–2 % of life at sea [10]. Hypothesis 2 investigates if a sample coming from the maritime industry differs in their implicit beliefs about male and female leaders, compared to a sample of consisting of university students. The student sample is of a more heterogenic background and composition.

2 Method

2.1 Research Design

The leader gender and the rater's background (university students or employees in the maritime industry) were independent between-group variables. The average of the 21 leadership attributes from the Global Leadership and Organizational Behavior Effectiveness (GLOBE) [24] of the two work domains were the dependent variables.

2.2 Samples and Procedures for Data Collection

The university student sample consisted of 578 participants from educational institutions in eastern Norway (268 females). The participants volunteered upon encouragement. They were approached during their lecture breaks in their respective university campuses. They were all briefed forehand that their involvement was voluntary and that they could withdraw their participation at any given time. The two versions of the questionnaire were stacked in an alternating sequence.

The sample from the maritime industry consisted of 21 participants (3 females) from the Norwegian maritime industry. They received a web-based version of the same questionnaire given to the student sample. The web-based questionnaire started with an information page, followed by a consent form. A randomization technique assigned the participant to either answer the female or the male versions of the questionnaire.

2.3 Ethical Considerations

The participants remained anonymous and that no personal information was gathered for this research. The student sample did not receive any written informed consent form but was rather given verbal information regarding their rights to privacy. No harm or discontent was reported.

2.4 Creation of the Questionnaire

The questionnaire used in this research project had its foundation in the GLOBE Project's framework of leadership [25]. The GLOBE framework consist of 112 leadership attributes that can be reduced into 21 primary leadership scales/attributes, which in turn can be reduced into six leader styles.

The questionnaire came in two versions. The first version was a 'male variant' with a description of a male CEO of a marketing firm and a male Captain of a passenger ship. The second version was a 'female variant' with a description of a female CEO of a marketing and a female Captain of a passenger ship.

Description of the CEO. "Jane/John Edwards is the CEO of a marketing firm that operates in large parts of Europe. Jane/John and the corporate team lead 60 employees with varying responsibilities and tasks within the firm. As CEO, She/He is enriched with authority and is involved in high-level decision-making. Her/His responsibility is to ensure corporate growth and the well-being of the firm and its employees, as well as creating strategies toward increasing both short and long-term value."

Description of the Captain: "Michelle/Michael Turner is captain of a passenger vessel traveling between Oslo and Kiel. Michelle/Michael leads a highly trained team with varying responsibilities within the ship. All onboard, including crew and passengers, are under her/his authority, ultimately rendering her/him responsible for the safety and efficiency of all operations during voyage. Among others, such operations include navigation, crew management, passenger well-being and so forth."

The participants were then asked to evaluate which of the 21 primary leadership dimensions would contribute to the particular leader becoming an outstanding leader. The rating scale ranged from 1 to 7, where 1 = "greatly inhibits outstanding leadership", and 7 = "contributes greatly to outstanding leadership". Table 1 shows an excerpt of the questionnaire used in the study.

Participants answered to what extent each of the leadership attributes contributed to outstanding leadership by rating each attribute 1–7 in the right-hand column.

Table 1 Excerpt of the male version of the paper questionnaire

	Leadership attributes	Associated characteristics	
1	Visionary	*He has foresight, exhibits preparedness, is anticipatory and plans ahead*	
2	Inspirational	*He is enthusiastic, positive, a morale booster and motive arouser*	
3	Self-sacrificial	*He is a risk taker, self-sacrificial and convincing*	
4	Integrity	*He is honest, sincere, just and trustworthy*	
5	Decisive	*He is willful, decisive, logical and intuitive*	

2.5 Data Analysis

All statistical analyses were done in IBM Statistical Package for Social Sciences (SPSS) version 22.

3 Results

Data were analyzed using repeated measure general linear model analysis (GLM). Classification of the size of observed effects follows Cohen's [26] classification of effect sizes for partial eta square(η_p^2)—small (0.01), medium (0.06), large (0.14) and Cohen's *d*—small (0.20), medium (0.50) and large (0.80).

3.1 Participants

The sample consisted of 579 students (268 males, 311 females) and 21 professionals from the maritime industry. The majority of participants were Norwegians (86 %). The students' age ranged from 19 to 54 years ($\bar{x}$ = 24.27, *SD* = 5.02). The maritime sample age ranged from 26 to 59 years ($\bar{x}$ = 42.67, *SD* = 10.25). There was a significant age difference between the samples (equal variances not assumed; $t_{20,349} = -8.191$; $\bar{x}_{\text{diff}} = -18.40$; 95 % CI of $\bar{x}_{\text{diff}}$ [−20.7, −16.1], $p = < 0.00001$), thus, we chose to control for age differences in the multivariate analyses.

3.2 Data Preparation

The scores were averaged across all the leadership scales to get an average score for the CEO and the Captain, respectively. These averages were then used in a statistical analysis using independent samples *t*-tests and the Multivariate General

Linear Model in IBM SPSS 22. The sum score of ratings on the 21 questions was for the CEO scenario while the CAP scenario was used as dependent variables.

3.3 Statistical Results

In order to test hypothesis 1, we did an independent samples *t*-test which indicated that there was a very small and not significant difference between the level that male and female leaders would need to be considered outstanding for both the CEO scenario ($t_{572} = -1.812$, $\bar{x}_{\text{diff}} = -1.61$, 95 % CI of $\bar{x}_{\text{diff}}$ [−3.35, 0.13], $p = 0.07$, Cohen's $d_s = 0.15$) and the Captain scenario ($t_{572} = 0.119$, $\bar{x}_{\text{diff}} = 0.10$, 95 % CI of $\bar{x}_{\text{diff}}$ [−1.59, 1.80], $p = 0.91$, Cohen's $d_s = 0.01$). This is not in accordance with the expectations stated in hypothesis 1. We have found no general tendency to have lower expectations to female leaders as compared to male leaders.

To investigate whether the sample from the maritime industry and the university students differs in the perception of how female and male leaders must perform to be considered outstanding leaders, we did a Multivariate General Linear Model with the sum scores of the CEO scenario and the Captain scenario as dependent variables. The Sample group (University students or maritime industry) and Gender of leader in the scenarios was used as independent variables. We found a significant two-way interaction between the leader gender and the two samples ($F_{2,\ 556} = 3.815$; $p = 0.023$, $\eta_p^2 = 0.014$; Wilk's $\Lambda = 0.986$). This effect was still significant after we controlled for age of participants ($F_{2,\ 552} = 3.835$; $p = 0.022$, $\eta_p^2 = 0.014$; Wilk's $\Lambda = 0.986$), hence indicating that the effect is not due to age

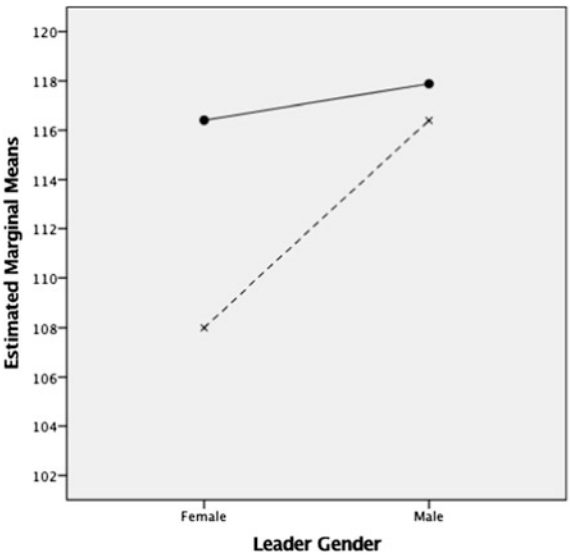


Fig. 1 Mean score on the CEO scenario for the interaction between sample and leader gender. The *dotted line* represents the sample from the maritime industry and the *whole line* represents the university student sample. As can be seen, the sample from the maritime industry give female leaders a lower rating than male leaders

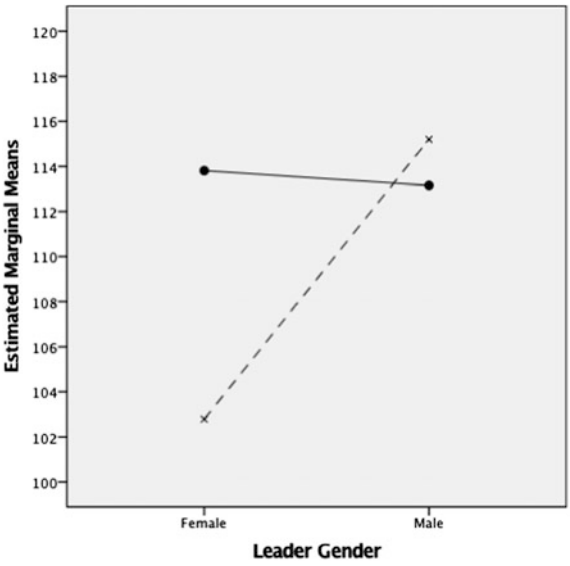


Fig. 2 Mean score on the captain scenario for the interaction between sample and leader gender. The *dotted line* represents the sample from the maritime industry and the *whole line* represents the university student sample. As can be seen, the sample maritime industry gives female leaders a much lower rating than male leaders

differences and intergenerational differences in perceptions of female leaders. The sample consisting of students rated male and female leaders as needing almost identical levels of leadership attributes to be considered outstanding while the maritime sample scored female leaders much lower than male leaders in both the CEO and Captain scenarios. A graphical visualization can be seen in Fig. 1 (CEO scenario) and in Fig. 2 (Captain scenario).

4 Discussion

Our findings did not validate hypothesis 1 that there is a general tendency that female leaders only needed to perform less than male leaders before being considered outstanding. The average for both genders across the two samples was similar for male and female leaders. This is in accordance with previous research conducted in Norway which found no differences between female and male leaders showing destructive leadership characteristics [27]. The rather progressive attitude of Norwegians towards issues of gender and equality as well as the low level of gender inequality in Norway (ranked 9th in the world in 2014 [28]) may have an influence on the findings of the research. Hence, our findings can be viewed within the context of national culture and might not be representative for other countries as there are indications that culture affects what leadership characteristics people endorse [17, 25].

However, when taking into account the samples we have, we found a two-way interaction supporting hypothesis 2 indicating that there is a tendency in the

maritime industry to have lower requirements for female leaders as compared to male leaders before being considered to be outstanding. This effect shows by the fact that female leaders were given much lower scores in both the CEO and the Captain scenario by the maritime sample but not by the university sample (see Figs. 1 and 2).

Our findings are in accordance with the theory of shifting standards [4] which states that different standards for evaluation can be used for evaluating male and female genders. We identified different sets of standards through questioning to what extent leadership characteristics contribute to outstanding leadership. With the use of two scenarios that differed only by the name of the involved leader (male or female), we can say that we are implicitly measuring the requirements people have for male and female genders. This effect can be translated into different standards for evaluation, hence indicating that females will be evaluated differently even though they are performing exactly similar to their male counterparts. As we have expected, our findings as well as findings from other studies have shown gender differences in the maritime industry [2]. Also, other studies show that the maritime industry is male dominated [10], and that gender issues in the industry are given little attention [12]. There is seemingly still work to be done to ensure gender equality in the maritime industry.

4.1 Limitations

The number of participants from the maritime industry is rather small and samples only comes from one country (Norway), hence generalizability of this results should only be done with great caution. On the other hand, our findings are in accordance with the expected findings—signifying the presence of different standards for evaluating female and male leaders in the maritime domain.

Another limitation that we found out from this research was that the average age of the maritime sample was older than the student sample. Hence, there is a possibility that intergenerational differences could have affected the data. However, by eliminating age as an explanatory factor in this study through controlling the age of participants, we found identical effects in our findings.

5 Conclusion

A comparison of the characteristics that leaders need to be considered outstanding showed no overall difference between female and male leaders, however respondents from the maritime industry gave female leaders much lower scores than male leaders thus indicating that there might be a gender bias in the evaluation of leaders in a real maritime industry environment.

References

1. Hollander, E.P.: The essential interdependence of leadership and followership. Curr. Dir. Psychol. Sci. **1**(2), 71–75 (1992)
2. Delgado, O.O., Øvergård, K.I., Henden, V.: Women are better leaders than they think: gender differences in the self-assessment of leadership skills in the maritime industry. In: Kitada, M., Williams, E., Loloma, L. (eds.) Maritime Women: Global Leadership, pp. 201–216. Springer, Berlin (2015)
3. Biernat, M., Fuegen, K.: Shifting standards and the evaluation of competence: complexity in gender-based judgment and decision making. J. Soc. Issues **57**(4), 707–724 (2001)
4. Biernat, M., Thompson, E.R.: Shifting standards and contextual variation in stereotyping. Eur. Rev. Soc. Psychol. **12**(1), 103–137 (2002)
5. Garcia-Retamero, R., López-Zafra, E.: Prejudice against women in male-congenial environments: perceptions of gender role congruity in leadership. Sex roles **55**(1–2), 51–61 (2006)
6. Wold, A., Wennerås, C.: Nepotism and sexism in peer review. Nature **387**(6631), 341–343 (1997)
7. Bornmann, L., Mutz, R., Daniel, H.D.: Gender differences in grant peer review: a meta-analysis. J. Inform. **1**(3), 226–238 (2007)
8. Stevenson, C.J.: Sustainable development issues in shipping: women, the under-represented human resource. In: Kitada, M., Williams, E., Loloma, L. (eds.) Maritime women: global leadership, pp. 255–266. Springer, Berlin (2015)
9. IMO.: STCW including 2010 Manila amendments:STCW Convention and STCW Code. International Maritime Organisation, London (2010)
10. Belcher, P., Sampson, H., Thomas, M., Veiga, J., Zhao, M.: Women Seafarers: global employment policies and practices. International Labor Office, Geneva, Switzerland (2003)
11. Kitada, M., Williams, E., Froholdt, L.L.: Maritime women: global leadership. Springer, Berlin, Germany (2015)
12. Cars, M.B., Osterman, C.: Mind the gap! maritime education for gender-equal career advancement. In: Kitada, M., Williams, E., Loloma, L. (eds.) Maritime women: global leadership, pp. 143–153. Springer, Berlin (2015)
13. Eden, D., Leviatan, U.: Implicit leadership theory as a determinant of the factor structure underlying supervisory behavior scales. J. Appl. Psychol. **60**(6), 736–741 (1975)
14. Fjærli, B.A.B., Øvergård, K.I., Westerberg, T.V.: Maritime mangers of the future—what do they think is good leadership? Transnav **9**(1), 107–111 (2015)
15. Hartog, D.N., House, R.J., Hanges, P.J., Ruiz-Quintanilla, S.R.: Culture specific and cross-culturally generalizable implicit leadership theories: Are attributes of charismatic/transformational leadership universally endorsed? Leadersh. Q. **10**(2), 219–256 (1999)
16. Javidan, M., House, R.J.: Cultural acumen for the global manager: lessons from project GLOBE. Org. Dyn. **29**(4), 289–305 (2001)
17. Javidan, M., Dorfman, P.W., Howell, J.P., Hanges, P.J.: Leadership and the cultural context: a theoretical and empirical examination based on the Project GLOBE. In: Nohria, N., Khurana, R. (eds.) Handbook of Leadership Theory and Practice, pp. 335–376. Harvard Business Press, Boston, Mass (2010)
18. Eagly, A.H., Karau, S.J.: Role congruity theory of prejudice toward female leaders. Psychol. Rev. **109**(3), 573–598 (2002)
19. Cevallos, D.C.: Participation of ecuadorian women in the maritime oil transportation sector. In: Kitada, M., Williams, E., Loloma, L. (eds.) Maritime women: global leadership, pp. 55–65. Springer, Berlin (2015)
20. Browne, K.R.: Evolved sex differences and occupational segregation. J. Organ. Behav. **27**(2), 143–163 (2006)
21. Miron, A.M., Branscombe, N.R., Biernat, M.: Motivated shifting of justice standards. Pers. Soc. Psychol. Bull. **36**(6), 768–779 (2010)

22. McGarry, A.: Leading change: the ITF women's maritime leadership programme. In: Kitada, M., Williams, E., Loloma L. (eds.) Maritime women: global leadership, pp. 23–34. Springer, Berlin (2015)
23. Randsley, J.: Boats are for boys: queering maritime archaeology. World Archaeol. **37**(4), 621–629 (2006)
24. House, R. J., Hanges, P. J., Javidan, M., Dorfman, P. W., Gupta, V. (eds.) Culture, Leadership, and Organizations: The GLOBE Study of 62 Societies. Sage publications (2004)
25. Javidan, M., Dorfman, P. W., Sully de Luque, M., House, R.J.: In the eye of the beholder: cross cultural lessons in leadership from project globe. Acad. Manag. Perspect. **20**(1), 67–90 (2006)
26. Cohen, J.: A power primer. Psychol Bull. **112**(1), 155–159 (1992)
27. Einarsen, S., Kaland, C., Hurley, M., Pedersen, L.L.N., Aasland, M.S.: Destruktiv ledelse: vurderes kvinnelige og mannlige ledere forskjellig? [Destructive leadership: are female and male leaders evaluated differently?]. Magma **2**(2014), 68–76 (2014)
28. United Nations Development Programme: Human Development Report 2015: Work for Human Development. New York, NY: United Nations Development Programme (2015) http://hdr.undp.org/sites/default/files/2015_human_development_report.pdf

Part VII
Human-Centered Learning Design

Scale and Spatial Resolution Guidelines for the Design of Virtual Engineering Laboratories

Brian Sanders, Dennis Vincenzi and Yuzhong Shen

Abstract In this paper we report on a pilot study conducted to identify tasks and understand scale and spatial resolution limits for the design of virtual engineering laboratories. The virtual environment is based on using the Oculus Rift SDK2 headset combined with the Leap Motion Controller (LMC) mounted on the headset. We first discuss a functional break-down structure to identify typical tasks conducted in a laboratory. From this functional breakdown basic gestures are identified to assist in virtual laboratory operations. Using this breakdown as a guide we developed two virtual environments. The first familiarizes the user with basic capabilities of the Rift and LMC. While the second environment was developed to measure scale and spatial effects of interfaces. This data will be used to guide the development of virtual laboratories environments for use in engineering degree programs and improve testing of these and other interfaces.

Keywords Virtual reality · Modeling and simulation · Engineering · Laboratories

B. Sanders (✉)
Department of Engineering Sciences, Embry-Riddle Aeronautical University, Daytona Beach, FL, USA
e-mail: sanderb7@erau.edu

D. Vincenzi
Department of Aeronautics, Undergraduate Studies, Embry-Riddle Aeronautical University, Daytona Beach, FL, USA
e-mail: vincenzd@erau.edu

Y. Shen
Department of Modeling, Simulation, and Visualization Engineering, Old Dominion University, Norfolk, VA, USA
e-mail: YShen@odu.ed

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1 Introduction

Online and other distributed learning environments are changing the academic landscape. This has the benefit of making education more accessible to a larger number of students, but this revolution in education does not come without challenges. Technically oriented degrees, for example, must meet accreditation requirements for interactive laboratories and team oriented experiences [1]. Team experiences are obviously a challenge when students are distributed both temporally and geographically. Some of this can be overcome with existing web-based communication tools like Blackboard® where students interact in written format. Plus, there are several other real-time virtual meeting environments such as Google Hangouts® and Skype®. These tools help students exchange ideas and practice their teamwork and communication skills. The primary challenge is to develop well crafted assignments and projects that require students to engage with each other in a meaningful manner.

There is not an equivalent level of capability to address the experimental aspect. Academic institutions can address this need to some degree through arrangements with local institutions and remote laboratories [2, 3]. However, this is not a global solution since they are not always available. Further, they do not offer the break from traditional teaching strategies that may be enabled by a technology-rich environment. More accessible solutions are possible with web-based modeling and simulation virtual environments. See for examples [4, 5], Virtual Labs (http://www.vlab.co.in/), and PHET Interactive Simulations (https://phet.colorado.edu/). These demonstrate terrific examples of the capability web-based tools can provide.

New technology, such as the Oculus Rift SDK2 and Leap Motion Controller (LMC), offer an increase in the interactivity and immersive capability possible over current, screen space environments mentioned above. The LMC is a 6 DOF positional tracking, contact-free input system for gesture-based human-computer interaction. It is primarily designed for hand gesture and finger position detection in interactive software applications (http://www.leapmotion.com). Together VR devices such as the Rift and the LMC can be used to develop immersive, interactive environments without the need of additional external devices such as a mouse or game controller.

2 Functionality and Usability of Input Devices

There is limited information reported in the scientific literature with respect to either the Rift or the LMC, but some studies are beginning to emerge. Bachmann et al. [6] conducted a study based on a Fitts' law-based analysis to measure user's performance in selection tasks with the LMC compared with a standard mouse. They reported an error rate of 7.8 % for the LMC and 2.8 % for the mouse device, movement times twice as large as for a mouse device, and high overall effort

ratings. The LMC's performance as an input device for everyday generic computer pointing tasks is rather limited, at least with regard to the selection recognition provided by the LMC [Bachmann]. They went on to report that for target widths of 40–20 mm and target distances up to 80 mm the LMC showed comparable error rates with a standard mouse device. Scicali and Bischof [7] developed several games to gauge user performance in different 3-D environments. They obtained excellent general information about several usable gestures. McCartney et al. [8] used data collected data from over 100 participants to train a 3D recognition model based. They reported an accuracy rate of 92.4 % with the goal of trying to gain support for the creation of a gesture-based language. Weichert et al. [9] developed an experiment making use of an industrial robot. They demonstrated that a precision accuracy of was obtained under static conditions and 1.2 mm for dynamic conditions. Guna et al. [10] found similar results. So while not as accurate as a mouse, the leap motion controller may be reliable and accurate enough for use in virtual, interactive laboratories.

These previous studies have investigated reliability, capability, and some limitations of the LMC compared to conventional approaches, (i.e., screen-space, mouse interaction). As some have pointed out the LMC will most likely not replace the mouse for every day use. This makes sense since the current environments, such as Microsoft Office, were not designed with this technology in mind. Thus, as suggested by Wigdor and Wixon [11] a different design philosophy should be considered and the interaction should be designed with the system capability in mind. The Oculus Rift and LMC have some terrific capabilities, and we seek to explore them for the design of virtual engineering laboratories.

As a first step, in this paper we begin to investigate spatial and resolution limits of interfaces to help guide the development of the virtual environments. A review of the Unity Asset Store and Leap Motion application site show some interactive concepts are readily available and more are coming along at a rapid pace. As opposed to focusing on the design of a new interface concept at this time we chose to identify existing approaches and develop a test methodology to determine its suitability for our needs. The rest of the paper describes how these interfaces were selected by first identifying typical task a user would perform in a laboratory. We then designed a simple set of tasks for users to perform and also conducted a post interview to gain insight into the user's experience, thoughts on suitability of the environment, and suggested upgrades to the test and other environments to which they were exposed.

3 Task Breakdown and Experimental Setup

The first step in the design process was to conduct a functional break down to identify typical tasks performed when conducting laboratory activities. This is a significant step in that it serves as a guide when selecting, and or designing, interfaces. Within the virtual laboratory there may be multiple activities as shown in

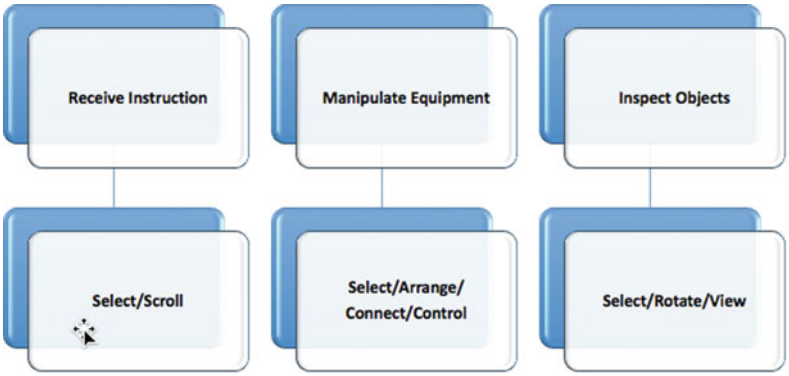


Fig. 1 Typical laboratory activities and tasks breakdown

Fig. 1. Activities can include receive instruction, manipulate equipment, and inspect experimental objects. When reviewing instructions, the ability to select and scroll pages of text maybe desirable. When it comes to the equipment control a user will want to be able to turn it on and off, precisely control some settings, yet at other times be able to freely explore a response space. We can also include the need to conduct basic observations and measurements on the experimental object of interest. For example, you may want to rotate an object to view it from multiple angles, measure its dimensions, etc.

From this basic construct we then identified different gesture based methods for which these activities could be performed. In this case, it would be appropriate to have binary controls to turn equipment on and off, smooth and continuous gestures to freely explore a design space or precisely select an experimental parameter on the piece of equipment. To meet these needs we selected the Leap Motion Widgets (…) as our first set of interfaces to evaluate. Widgets include buttons, sliders, and dials. All of which can be easily sized, configured, and integrated into virtual environments. In this investigation three mechanisms were tested: buttons, sliders, and dials. We report mainly on the feedback from the buttons here since they were the most detailed assessment.

Three different button sizes were tested in two different arrangements. As shown in Fig. 2 the buttons sizes included 5, 2.5, and 1.5 cm. This ranges from approximately the size of 2–3 fingers held together to the size of a standard keyboard key. Five buttons were arranged in two different configurations as shown in Fig. 3. For the configuration on the left the space between buttons is equivalent to the button size. Participants where given visual cues as to what button to press via information displayed in a heads-up-display (HUD) in the goggles and also an aural clue using the computer based text-to-speech capability. This test enabled us to explore the size and spatial arrangement of the interface as well as acquire user preferences about setup, environment, and interface feedback.

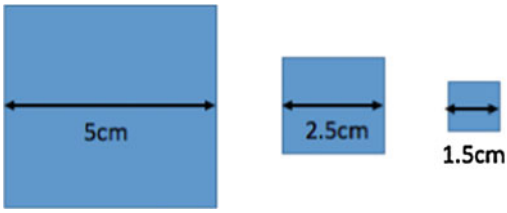


Fig. 2 Button sizes—not actual sizes but to scale

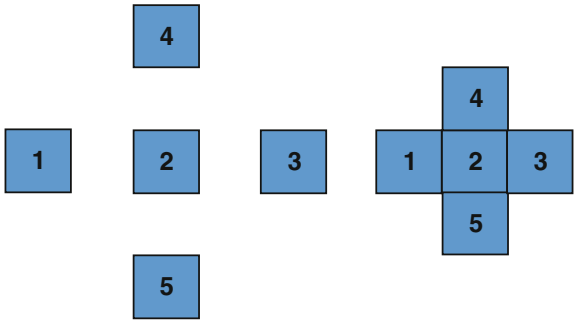


Fig. 3 Two button configurations tested

The physical setup is shown in Fig. 4. In this case one of the authors is shown in the seated position wearing the Oculus Rift goggles. The LMC is mounted on the front of the googles. The LMC has a Field of view of 150° with approximately 8 cubic feet of workspace (leapmotion.com). The largest area is about the size of a beach ball. It will be discussed later in the paper, but one of the interview questions sought to understand where users like to position their hands. The virtual environments were built in Unity3D®. All test were run on a Dell Precision T3610 workstation with 8 GB of RAM and a NVIDIA Quadro K4000, 8 GB graphics card.



Fig. 4 Virtual reality equipment and setup

4 Results, Discussion and Lessons Learned

The first environment to which users were exposed is shown in Fig. 5. The purpose of this environment was to familiarize the user with the immersive visual environment, operation of the LMC, and develop hand-eye coordination. The users motion was limited to head movement. So they were capable of rotating the view by turning their head to look around the scene as well as some translational movement. The participants were encouraged to explore the range of operation of the LMC as well as preferred hand positions. The preferred hand position was typically around 30–40 cm in front and slightly below eye level.

A few simple gestures in this environment included pushing various size blocks around the table top and swiping gestures to spin the basketball. Once the user became familiar with these tasks, they proceeded to explore pushing buttons (i.e., pushing blocks around the table) and adjusting the vertical and horizontal slider bars (i.e., spinning the basket ball). Users typically spent around 5–10 min playing in this environment and becoming familiar with how to operate in it. Feedback included wanting acoustic feedback and proximity awareness (i.e., some indication they were close to an interface). They stated it may help makeup for the lack of tactile touch. Also, while the user can turn their head close to 90°, it appeared to the test observer that it may be better to design environments where most of the interaction takes place in the ±60° range of the horizontal plane. A similar metric needs to be developed for the vertical plane. This was observed as users extended their arms well above their head to obtain the full motion of the vertical slider.

Typical results with the virtual button interfaces are shown in Figs. 6 through Fig. 8. Figure 6 shows a representative attempt versus response time. This was the time required to request the action (i.e., press button 5) plus the time it takes the user to complete the action. When first exposed to a scene there was some adjustment period, but the user quickly settled in. The data consistently showed a

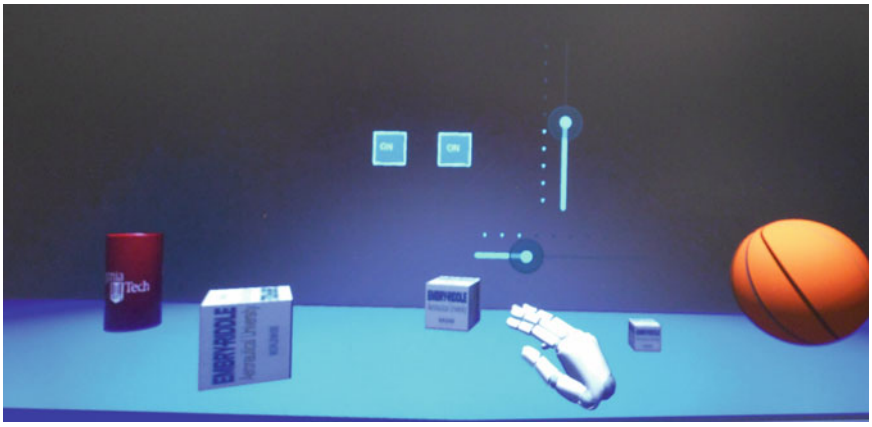


Fig. 5 User introduction to the virtual environment

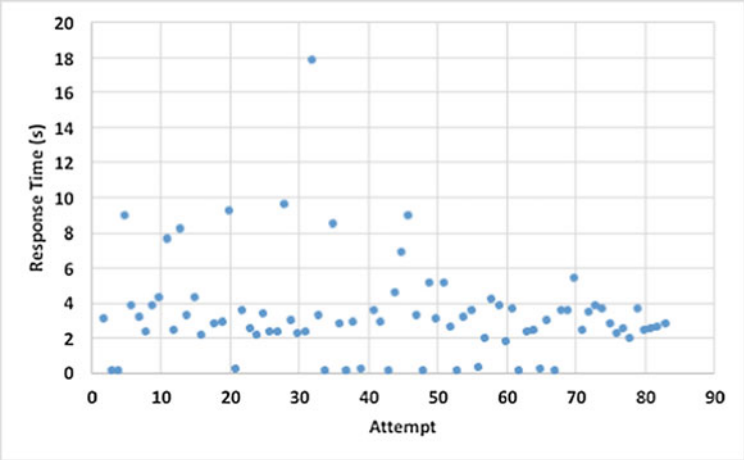


Fig. 6 Typical participant response pattern

tight band of response time. It this case it was in the 2–4 s range. The response times close to zero are errors. These were recorded when the user accidently pressed more than one button at a time. This is something that will be corrected in later tests. The longer times typically occurred when the participant was searching for an unobstructed path to a button such as for numbers 2, 3 and 4 for a right handed individual. This is an indication that different design patterns need to be considered.

Figure 7 shows the average response times per scene for all pilot study participants. Each participant first progressed through three scenes that used the

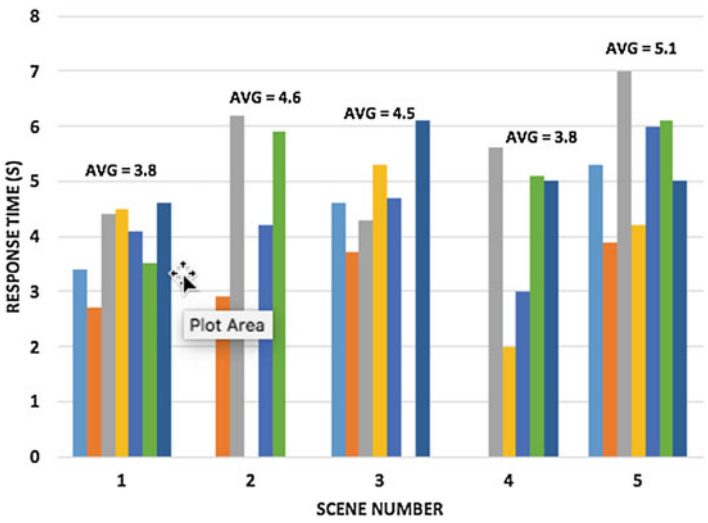


Fig. 7 Average response versus scene for participants

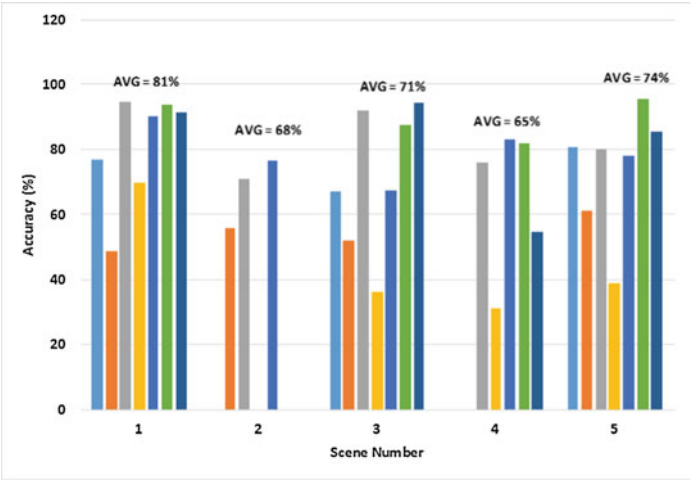


Fig. 8 Accuracy versus scene for all participants

configuration shown on the left side of Fig. 3. Those are labeled as scenes 1, 3, and 5 and the button sizes where 5, 2.5, and 1.5 cm, respectively. Then, some users explored Scenes 2 and 4 which used the configuration on the right side of Fig. 3 for the 5 and 2.5 cm size buttons, respectively. A slight rise in response time on the order of about 1.5 s was observed when progressing from Scene's 1, 3, to 5. This is not definitive at this point due to the small size and how errors were recorded. For example, if a user accidently pressed 3 buttons that might have been recorded as multiple errors with close to zero response time and thus bringing down the average. The test is being refined to record this as one error. The buttons themselves are nicely designed with visual feedback to indicate on/off positions and also engagement using a spring like motion. We also added some aural feedback in the form "beeps and squeaks", which the participants rated favorably. Several users expressed a desire for proximity feedback such as an indication that they were getting close to the interface or may have moved beyond it.

Figure 8 shows the average accuracy for all study participants and scenes. For less dense configuration (shown left side of Fig. 3), the overall average accuracy per scene dropped from approximately 80 % to the low 70 % range as the button size decreased. It dropped into the upper 60 % range for the denser configuration, which is shown on the right hand size of Fig. 3. Several participants expressed that the higher density arrangement had the advantage of not having to search for a clear path to a button. Again, the test approach needs to be refined and more data gathered but this information guides us in the arrangement. For example, maybe a grid structure (i.e., 3 $\times$ 3 arrangement) would work just fine, but it would need to be rotated out of the plane such that the bottom rows do not cause a path obstruction.

5 Summary and Conclusion

In this paper we reported on the results of a pilot study to identify and assess interfaces for the design of virtual engineering laboratories. This was accomplished using a combination of the Oculus Rift Head Set and Leap Motion Controller to track hand gestures. We explored using a task breakdown structure to identify typical laboratory activities and tasks to drive the selection of interface requirements. Tests were then conducted on a limited sample size to gage user satisfaction and ability with the interfaces, solicit feedback, and refine test procedures and data collection metrics. Task accuracies on the order of 75 % were observed with a response time on the order of 4 s. Additional data needs to be gathered to refine these metrics, but the interface shows promise for the design of the laboratories. This study also demonstrated the need to practice with this technology and maybe even design interfaces tailored to user skill level. Future tests will refine the data gathering processes and investigate suitability of other Leap Motion Widgets as well as other interfaces.

The implementation of this technology in more widespread uses outside the well-funded government and academic lab environment is inevitable. With the cost of this technology decreasing, and fidelity and resolution increasing, new uses such as the design of virtual engineering laboratories will begin to flourish and take advantage of these new capabilities. Developing applications that are tailored to utilize the new capabilities being offered makes sense and allows users and developers the ability to optimize and compliment existing education and training platforms such as online and distance learning that are currently limited compared to classroom based programs.

References

1. Engineering Accreditation Commission: Criteria for Accrediting Engineering Programs. Accreditation Board for Engineering and Technology, Author, Baltimore, MD. http://www.abet.org/wp-content/uploads/2015/05/E001-15-16-EAC-Criteria-03-10-15.pdf (2014)
2. Nickerson, J.V., Corter, J.E., Esche, S.K., Chassapois, C.: A model for evaluating the effectiveness of remote engineering laboratories and simulations in education. Comput. Educ. **49**, 708–725 (2007)
3. Velasco, F.J., Revestido, E., Moyano, E., LóPez, E.: Remote laboratory for marine vehicles experimentation. Comput. Appl. Eng. Educ. **20**, 728–740 (2012)
4. Tucker. C., Moore, J.: Using unity to implement a virtual crash site investigation laboratory in support of distance learning objectives (Paper no. 14050). Paper presented at the Interservice/Industry, Training, Simulation and Education Conference, Orlando, FL (2014)
5. Sanders, B, Terwillinger, B, Witcher, K., Leary, M., Olhman, J., Tuker, C.: Design of an educational tool for unmanned air vehicle design and analysis. In: Interservice/Industry Training, Simulation, and Education Conference (I/ITSEC) (2015)
6. Bachmann, D., Weichert, F., Rinkenauer, G.: Evaluation of the leap motion controller as a new contact-free pointing device. Sensors **15**(1), 214–233 (2015). doi:10.3390/s150100214

7. Scicali, A., Bischof, H.: Usability study of leap motion controller. Paper presented at the 39–43. http://search.proquest.com.ezproxy.libproxy.db.erau.edu/docview/1705964961?accountid=27203 (2015)
8. McCartney, R., Yuan, J., Bischof, H.: Gesture recognition with the leap motion controller. Paper presented at the 3–9. http://search.proquest.com.ezproxy.libproxy.db.erau.edu/docview/1706223578?accountid=27203 (2015)
9. Weichert, F., Bachmann, D., Rudak, B., Fisseler, D.: Analysis of the accuracy and robustness of the leap motion controller. Sensors **13**(5), 6380–6393 (2013). doi:10.3390/s130506380
10. Guna, J., Jakus, G., Pogacnik, M., Tomazic, S., Sodnik, J.: An analysis of the precision and reliability of the leap motion sensor and its suitability for static and dynamic tracking. Sensors **14**(2), 3702–3720 (2014). doi:10.3390/s140203702
11. Wigdor, D, Wixon, D.: Brave NUI World: Designing Natural Interfaces for Touch and Gesture. Morgan Kaufmann, Burlington, MA. doi:10.1145/2047414.2047439 http://doi.acm.org/10.1145/2047414.2047439 (2011)

Improvement to the Usability of Hybrid Courses in Degree Programs at URJC Online

Manuel Gertrudix-Barrio, Natalia Esteban, Mario Rajas and Maria Redmon

Abstract In 2015, a study was conducted within the program for the improvement of hybrid and distance learning courses developed by the Universidad Rey Juan Carlos, Spain. The purpose was to identify student difficulties that arise throughout the course, identifying possible improvements (regarding the design, interaction, and logic) and obtaining a list of items to be changed to improve students' overall experience. A/B split testing was used in the development of the research, by means of 10 s judgment tests offering a variation in the distribution of the elements in the interface of two models. Activities were recorded by means of screen and sound capture of the users' comments explaining the actions they were taking and the reason why they were doing so. The main conclusions are: facilitating recurrent access itineraries, improving tagging, offering documents in a standard and accessible format, differentiating types of content clearly and guaranteeing a single organisational logic for all courses.

Keywords Interface · User experience · eLearning · Usability · LMS · Moodle

M. Gertrudix-Barrio (✉) · N. Esteban · M. Rajas
Center of Innovation in Digital Education, URJC Online, C/Tulipan s/n, 28934 Madrid, Spain
e-mail: manuel.gertrudix@urjc.es

N. Esteban
e-mail: natalia.esteban@urjc.es

M. Rajas
e-mail: mario.rajas@urjc.es

M. Redmon
College of Arts & Humanities, University of Central Florida, 4000 Central Florida Blvd, Orlando, FL 32816, USA
e-mail: maria.redmon@ucf.edu

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1 Introduction

A key aspect for the success of a virtual teaching/learning process is knowing what are the ideal structural characteristics and informational architecture for the student to be able to carry out their activities within the Virtual Classroom in the most efficient way [1, 2].

Within the improvement programme for semi-presential and distance qualifications developed by Universidad Rey Juan Carlos de España [3], a study was carried out on the usability of the virtual learning environment Moodle during April 2015. The study sought to understand the best way of organising the information within a model course. The object was to analyse what structure is most suitable for the information from a student perspective so that necessary improvements made to the design of the courses can be identified. Also a data template can be generated containing the structure that provides the student with the best user experience.

To do so, the following elements were analysed: (a) the updated evaluation of the interface, (b) the expectations of the student of this interface, and (c) the ease with which the students locate the information presented within the Virtual Classroom. Furthermore, it evaluated how the students carry out operations such as establishing a communication process, locating an educational activity, and carrying out a task.

The purpose was to identify the difficulties that students encounter while taking a course, identifying possible improvements (in terms of design, interaction model, and organisational logic), and obtaining a series of recommendations to improve the experience of the student.

2 Method

To carry out the research an A/B Split testing test was used, by means of 10 s judgment tests, in which the distribution of elements of the interface was varied between two models A and B, to understood where each model best fulfilled the proposed objectives. The students, 26 for model A and 16 for B, carried out a series of tasks, navigating through two courses with different configurations in the Virtual Classroom interface, created with its own template for Moodle 2.7.

The activity was recorded by screen and sound capture of users' comments, in which they explained the actions they were carrying out and the reason for doing so. The test was completed with a series of test type questions in which users were asked for a general evaluation of the interface.

The test was carried out with two different configurations of a course in a Virtual Classroom. The configurations only affected structural elements of the template (organisation of tabs and labelling), keeping other elements such as the design or general blocks stable. As the number of users who carried out the task was different between one model and the other, percentages were always used to allow for comparison (Fig 1).



Fig. 1 Configuration of the model A course

During the completion of the tests the comments and explanations of the students were recorded. Although they are limited, all inputs were used (comments, cursor movements, written responses) to allow conclusions to be drawn.

Model A was used by 26 students and model B by 16 students. Before carrying out the test the students were informed of its particulars through a meeting by videoconference, and received a detailed guide with "test instructions".

In the description of results, a first descriptive section was created which presents a summary of the results of the tasks in Model A, then in Model B, and a comparison of both models. In the conclusions section a more qualitative evaluation was made and recommendations for improvement provided.

3 Description of Results

The analysis of the tests was carried out manually, reviewing the audio-visual recording of all tests and noting the analysed elements: time to carry out the task, user comments, achievement or non-achievement and navigation.

3.1 Location of the Course Activities

The first task for the student was to locate the general information of the course: *Imagine that you are at the start of the course and want information on it. Check the breakdown of activities that you should complete to pass the course. How many activities must you complete in total*?

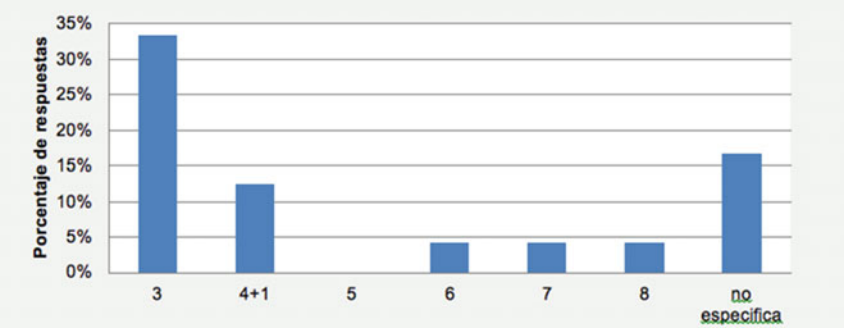


Fig. 2 Number of activities identified by students (percentage of answers) (does not specify)

The average time invested by users for completing the task was 2:35 min (median of 2:31) for model A, and 1:56 min (median of 2:30) for model B.

There is no consistency in terms of the number of activities that the students understand that they must complete. Three activities is the most repeated option, mainly due to the "Evaluation" section containing three exercises and it appears that the users understand the "Evaluation" information that is not given by the Study Guide (pdf or timeline) more clearly (Fig. 2).

Users see all content—such as "Multimedia Summary" and "Summary Table"—but the level of interaction is rather low. It is supposed that users do not believe that this content will give them the information that they are seeking. This may be due to the design being visually complex, especially in the case of the "Multimedia Summary". In the case of the "Summary Table", a direct link to a pdf would be more effective.

The "Summary Table" was impractical as the content is cut off, too small, and the controls for zooming or moving are not sufficiently intuitive.

Given that there are a large number of students accessing the "General Information" section to search for the activities of the course, here a link to the content of the "Study Guide" should be shown.

One of the problems identified is that there are too many overlapping sources of information: teaching guide, multimedia summary of the study guide and summary table of the study guide. The difference between these different sources is not clear, and from the students' point of view this is confusing. A solution would be to compile all information in a single document in a structured manner, and additionally to show the information in a more visual and interactive way through a very simple module. Likewise, it is important for key information to be shown quickly and for it to be visualised immediately.

On the screens on which the text is shown, an excessive length with a long scroll puts at a disadvantage the information shown in the lower section. Therefore, it is important to put the information that is essential for the student in the upper section.

Having analysed the results from the two models, a combination of both would be more effective. In it, there would be an initial section with a brief introduction

and links to the main sections. It is more effective to have an item on the main menu that is the "Study Guide", as in Model B, in which all information about the general operation of the course is given. Ideally, duplicated information should be reduced, offering information in a simple visual and intuitive manner.

3.2 Location of Tutorial Timetables

The second task required the student to locate information on the course tutorial timetable: *Imagine that you are interested in finding the timetable for tutorials with the teacher. What days and times can tutorials be carried out*?

The average time for users to carry out the task was 1:02 min (median 0:59). This task was only successfully carried out by 88 % of users in model A and 100 % in model B.

In both models the users found the information quickly, although in the case of Model B, users did so with fewer clicks.

Currently, little information is provided about the teaching staff, and, therefore, it could be in "General Information" directly, as in Model B. If more information is provided (if there are several teachers or times, a photo and other information is shown) it would then be recommended to have a "Teaching Staff" section as in Model A, and to put a link in the "General Information" section such as "Check tutor availability" with a "Teaching Staff" link.

3.3 Submission of a Task

In the third task the student should locate where a task submission is carried out: *Imagine that you have started the course and must make the first submission of an evaluation exercise. Access the space where you should make the submission of the activity called exercise 1 (it is not necessary for you to upload the file).*

In model A, 78 % of the students carried out the task correctly, and 73 % from model B. The most viewed section as a first option is "Evaluation" with 71 % followed by "Content" with 25 %, and finally others (my courses or main page) with 4 %.

The average time spent by users carrying out the task was 1:02 min (median 0:46) for model A and 0:45 min (average 0:54) for model B.

For students it was confusing that there were two possible ways of uploading a file, as in the case of model A, where there are two different options if you access the exercise from the unit or from the evaluation menu (the title and the navigation line are different). In practical terms it makes sense that the user be able to search for the way to upload the exercise directly in the module and also in "Evaluation", but for this it would be necessary to create a link to the Module which leads to the specific exercise of that course.

Students took less time to carry out this task in model B, and the completion percentage is 2 % less, but it is possible that model A is more flexible in adapting to different cases. In courses in which there are few units taught, perhaps it would not be necessary to have the "Evaluation" section as in model B. Conversely, in cases where there are many units, it may be easier to have all activities of the course grouped in "Evaluation" and also have the links to each teaching unit.

3.4 Ask a Question in the Forum

The fourth task was for the student to ask a question on an issue through the forum: *Imagine that you are working on the content of topic 5 and you decide to ask your teacher a question through the forum. Access the place from which you would send your question (you do not have to send it).*

The average time spent by users carrying out the tasks has 0:54 min (median 0:58) in model A, and 0:54 min (median 0:51) in model B.

Students show interest in having access to the specific forums of each module in the "General Forum", and so regardless of where they are located it is recommended to have a link connecting the general forum with the forums of each module.

On the "Contents" page of each module it is important to differentiate the types of content in a more visual way, avoiding grouping them all in one list.

It is interesting that more students carried out the task correctly in module B than in module A, as the access is located in the same place. However, considering that the task defines the term "Unit" and that the menu of model B also has the word "Units", easy recognition is established.

3.5 Level of Satisfaction

Students believe that the organisation of the course aids its completion (70 % model A, 82 % model B, accumulating the two most positive answers). There are more discrepancies in model B than in model A, but there are in turn more people who evaluate it positively (Fig 3).

There is also a certain consensus on the platform having functionalities that are useful for completing the tasks of the course. There are more positive opinions in model B (71 %) than model A (65 %). Nevertheless, model B has more negative answers (Fig 4).

In terms of whether finding information within the course is easy, there are more positive opinions related to this statement in model A (77 %) than in model B (53 %). There are more negative opinions in model B (18 %) than in model A (7 %). There are no very negative opinions in either case.

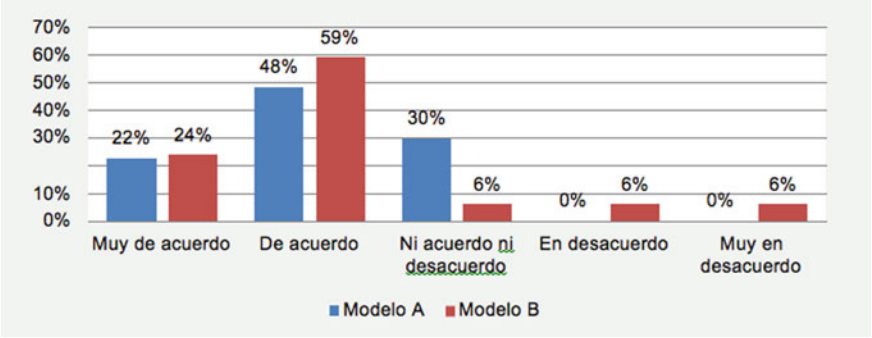


Fig. 3 Evaluation of whether the organisation of the course aids its completion (strongly agree, agree, neither agree nor disagree, disagree, strongly disagree) (model A, model B)

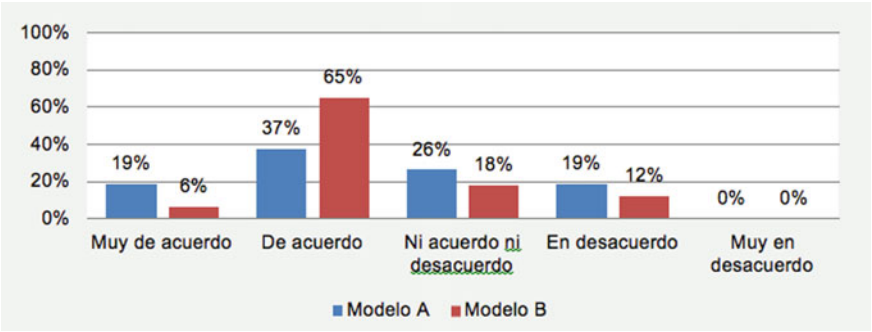


Fig. 4 Evaluation of whether the platform has useful functionalities (strongly agree, agree, neither agree nor disagree, disagree, strongly disagree) (model A, model B)

A high percentage of students (82 % in model B and 63 % in model A) believe that the course is organised in an intuitive way. There are more positive opinions in model B, however for model B some negative opinions were also expressed (6 %).

Finally, the general impression of the structure of the course is positive, more so for model B (88 %) than model A (70 %). There are more neutral or negative opinions in model B (33 %) compared with model A (12 %).

As in the rest of the analysed elements, in overall terms there is no great difference between the two models. The total "strongly agree" and "agree" opinions is higher for model B than model A, but the number of negative opinions is also higher. Model A has more "strongly agree" and "neither agree nor disagree" opinions. Overall, model B has more positive opinions and more negative opinions, while model A has more neutral opinions and no negative opinions.

4 Conclusions

The results obtained are not conclusive about which model is better. Considering the time factor, students carried out the tasks more quickly in model B. Nevertheless, in two of the tasks, the rate of achievement was higher in model A. In the surveys, the results are also close. For this reason, it is considered that the main interest should be to focus on which aspects of the platform to improve to create a model which functions better than A and B separately.

The time that the students have required for completing the tasks does not seem relevant as the differences between the models are minimal and the times are not a determining factor.

In the tests, it was observed, that if there are fewer options there is less chance of error. However, taking into account that the platform must be standardised for all types of courses, and that there will be courses with a larger number of units and/or activities, extreme simplification may cause problems for courses with more content. The conclusion is that the positive aspects of the two models should be combined to design one platform that facilitates the completion of tasks in all cases concurrently. This aspect was indicated by previous studies [4, 5].

Below some of the improvements to be made are described, drawn from the analysis of the results obtained:

For actions that are key for the student, such as, for example, submitting an exercise, allowing the same point to be accessed from different sections. It is observed that there are students who prefer to have exercises within the unit and others in a separate section. Most important, it would be ideal to maintain a separate section, and to put links to each exercise in each unit to facilitate access.

Revising the labelling, considering that the change of terminology or names of some sections could facilitate navigation and students' finding information. For example, in the section called "Evaluation" it would be better to put "Exercises and Evaluation". Students understand submissions to be exercises, and therefore a menu with this name would allow easy identification of where to submit. Likewise, it is important to use consistent terminology and explain it to students; an aspect that is consistent with other previous studies [6, 7].

Offering information and material in a standard and format that is accessible for all. The multimedia summary or summary table is impractical and not intuitive, and has a different format, so many users do not pay attention to it. The incorporation of more interactive elements for supporting the learning process must be carried out taking into account aspects such as design, type of content, size, etc.

It is essential to consider the different contexts in which students will take the course. In some cases students will wish to access the content offline, print, or edit the content. Therefore, it is also necessary to provide access to the material in pdf format.

To facilitate access to the information, the different types of content found within a unit must be more clearly identified. It would be ideal to be able to use a type of

box or graphic resource to differentiate reading in forums and activities, as the current icons are not very differentiating.

The content of the Teaching Guide and the Study Guide, including the multimedia summary and the summary table, is not clear and gives the impression that there is an overlap of information in many cases. The content of the study plan of the course must offer a single source of information. It is important to unify the content covering the same topic to avoid users' having to consult different sources.

One of the most important aspects for the platform to function correctly is that all teachers use the same logic when uploading content, activities, alerts, etc. It essential to intensify support to teachers so that they can use the tool in a standardised manner, because, as has been indicated, usability also greatly depends on the users, their objectives and the environment in which the product is used [8].

Finally, there is the need to repeat the study applying standardised scales such as the SUS (System Usability Scale) [9] and the Student Centred eLearning Environment [10].

References

1. Davis, R., Wong, D.: Conceptualizing and measuring the optimal experience of the eLearning environment. Decis. Sci. J. Innovative Educ. **5**(1), 97–126 (2007)
2. Althobaiti, M.M., Mayhew, P.: Assessing the usability of learning management system: user experience study. In: E-Learning, E-Education, and Online Training. Springer International Publishing, pp. 9–18 (2015)
3. Gertrudix, M., Rajas, M., Esteban, N.: URJC online. Plan estratégico para la mejora de la enseñanza en entornos virtuales." Formación virtual inclusiva y de calidad para el siglo XXI: actas del VI Congreso Internacional sobre Calidad y Accesibilidad de la Formación Virtual) (2015)
4. Ricardo, A.D.G., González, Y.A., Norchales, Y.M.: Propuesta de un Manual de Usabilidad y Accesibilidad para el Desarrollo de Personalizaciones de la plataforma de teleformación MOODLE. Edutec: Revista electrónica de tecnología educativa, **34**, 8 (2010)
5. Ternauciuc, A., Vasiu, R.: Testing usability in moodle: when and how to do it. in intelligent systems and informatics (SISY). In: 2015 IEEE 13th International Symposium on 263–268. IEEE (2015, September)
6. Koohang, A., Paliszkiewicz, J.: E-learning courseware usability: building a theoretical model. J. Comput. Inf. Syst. **56**(1), 55–61 (2016)
7. Medina-Flores, R., Morales-Gamboa, R.: Usability evaluation by experts of a learning management system. Tecnologias del Aprendizaje, IEEE Revista Iberoamericana de **10**(4), 197–203 (2015)
8. Campos, J.V., dos Anjos, T. P., Gontijo, L.A., Vieira, M.L.H.: A usabilidade e acessibilidade de um ambiente virtual de aprendizagem com foco no usuário idoso: uma verificação ergonômica do Moodle. AtoZ: novas práticas em informação e conhecimento **4**(1), 10–23 (2015)
9. Orfanou, K., Tselios, N., Katsanos, C.: Perceived usability evaluation of learning management systems: empirical evaluation of the system usability scale. Int. Rev. Res. Open Distrib. Learn. **16**(2) (2015)
10. Junus, I.S., Santoso, H.B., Isal, R.Y.K., Utomo, A.Y.: Usability evaluation of the student centered e-learning environment. Int. Rev. Res. Open Distrib Learn. **16**(4) (2015)

An Analysis of Learner Experience with MOOCs in Mobile and Desktop Learning Environment

Fisnik Dalipi, Ali Shariq Imran, Florim Idrizi and Hesat Aliu

Abstract Massive Open Online Courses (MOOCs) are now the most recent topic within the field of e-learning. They have the potential to influence the higher education environments significantly worldwide by creating a completely new and large market of educational resources by overpassing the traditional universities market share due to their physical limitations. However, due to the many differences between mobile devices and desktop environments, the introduction of mobile technology in MOOC environment is challenging. Hence, the main objective of this paper is to study and compare the learner's experience in different learning environments by using mobile devices and PCs while performing given tasks related to MOOCs. To achieve this goal, we conduct a subjective experiment with various MOOCs related tasks to be performed in mobile and desktop learning environment. The results of the findings show that the difficulties learners have experienced in the mobile environment are more expressed. Moreover, their satisfactory level is much higher in the desktop environment.

Keywords MOOCs · Mobile devices · Desktop environment · e-Learning

F. Dalipi (✉) · A.S. Imran
Faculty of Computer Science and Media Technology,
Norwegian University of Science and Technology (NTNU), Trondheim, Norway
e-mail: fisnik.dalipi@ntnu.no

A.S. Imran
e-mail: ali.imran@ntnu.no

F. Dalipi · F. Idrizi · H. Aliu
Faculty of Mathematics and Natural Sciences, Tetovo University, Tetovo, Macedonia
e-mail: florim.idrizi@unite.edu.mk

H. Aliu
e-mail: hesat.aliu@unite.edu.mk

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1 Introduction

Online technologies are transforming education both in quality and scale. Due to this technology development and revolution, eLearning has become a widespread method of disseminating and acquiring knowledge.

One of the most recent and popular e-learning models used to leverage and improve the process of teaching and learning are Massive Open Online Courses (MOOCs). In particular, they represent a dramatic stage in web-based education systems that have been enabled by the rapid growth of Internet access and the increase in bandwidths over the past decade [1].

In addition to traditional course materials such as videos, readings, presentations, audio recordings, and problem sets, MOOC provides an interactive user experience that helps design community for students and teachers.

MOOC platforms require much effort to care for the user experience [2]. Therefore, to shed more light in this direction, with this paper we extend our earlier work [3], where we conducted an experiment on MOOCs usability analysis in a desktop setting, aiming to capture the learner's facial expressions.

However, the introduction of mobile technologies in MOOCs environments is a challenging task, mainly due to many differences between mobile and desktop setting. These differences include interaction techniques and to some extent some restrictions in user interaction.

The primary objective of this paper is to study the learner's experience in different learning environments by using mobile devices and desktop PCs while performing given educational tasks related to MOOCs.

We guide our study by the following research questions:

1. Can different devices affect learner's attention or emotions in online learning scenarios?
2. What will be the learning experience in cases when using different devices?
3. What are the limitations and advantages of mobile or PC learning environment with MOOCs?

The rest of the paper is structured as follow: Section 2 outlines the related work in the field. Section 3 presents the experimental setting. In Sect. 4, we present the findings and the related discussions. Lastly, Sect. 5 concludes this paper.

2 Related Work

MOOCs have been widely investigated and have become one of the most attractive research topics in higher education. Many MOOC providers are now optimizing their courses for access from mobile phones or tablets, by developing mobile apps in addition to the desktop version of the courses. In doing so, MOOC designers are facing challenges while adapting the course for usage on a different type of devices.

Furthermore, as reported in [4], there are several requirements for designing an m-learning tool: portability, connection to an individual, retrieving knowledge without the technology becoming a deterrent, communication, adaptation to learners development, persistence, usefulness, and user-friendliness.

Mobile devices can improve communication possibilities and facilitate social interaction, collaboration and learning [5].

Valderama et al., in their work [6] suggest that mobile phones are a versatile and powerful tools that can be used in the classroom to foster student's engagement and to support instructional activities in MOOCs. Another study to identify differences between the difficulties that users experience on mobile and desktop environments is conducted by [7]. In this work, the difficulties are regarded to participants having an Internet connection on their mobile devices or not, and it is found that mobile technologies combined with Internet access might be very useful and effective in terms of interaction.

Some work concerning challenges and opportunities as well as the criterion for comparing MOOCs in mobile and desktop environment setting are given in [8, 9]. Bralic et al. [8] investigate the potential of adjusting MOOCs for desktop and mobile environment and propose a framework for comparisons between mobile and desktop versions of MOOCs.

Marco et al. [9] raises the question of many differences between mobile devices and desktop environments when using MOOCs, and based on the differences they find and analyze strategies and changes in a user's behavior in offline contexts using mobile devices. By applying a case study, after the primary strategies are considered, the most suitable strategy is used to test a web application's feasibility in offline scenarios. The mobile support of different MOOC providers is also studied by [10]. The authors address the offline gap in a mobile learner's MOOCs usage, which is essential to be solved to provide a ubiquitous user experience and to satisfy the user's' requests.

As reported in the literature, besides advantages that MOOCs have in desktop environments, there are various aspects and strategies of integrating mobile technologies to facilitate learning with MOOCs. To better understand the learner's experience with different learning environments, after giving students several education tasks to be performed in both, mobile and desktop environment, we conducted a survey asking students about their experience with MOOCs in the respective environment.

3 Experimental Setup

To answer the research questions, we design an experiment for this purpose. The experiment framework, presented in Fig. 1, consists of two stages. In the first stage, for each of the learning environment, the learner is asked to perform three educational tasks with three different MOOCs (Coursera, edX, Udacity). A sample of the tasks performed for one of the MOOC platforms are as following:

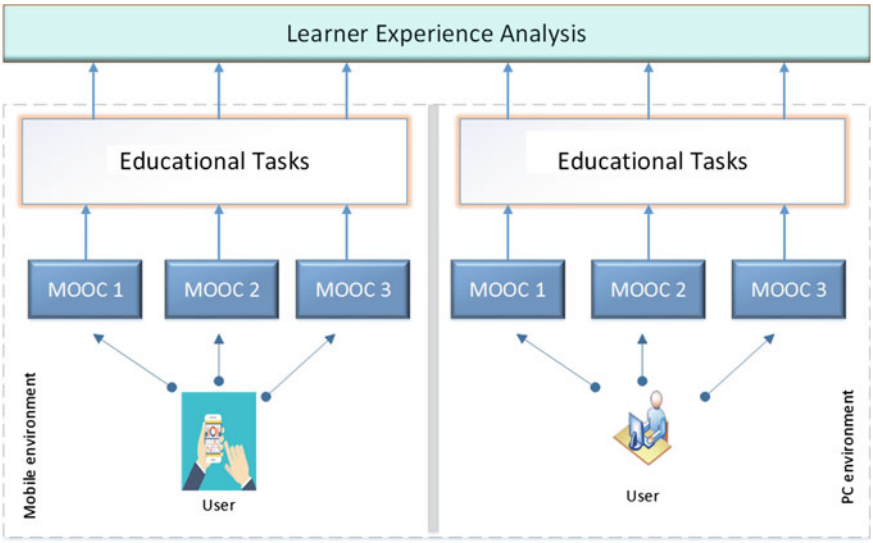


Fig. 1 Workflow scenario of learner's experience analysis experiment

Task 1: Find a given course by "person_name" in the specified MOOC platform.

Task 2: Register any course of your choice in biology, informatics, medicine or economy.

- identify reasons for selecting this course:

1. course duration
2. certificate
3. fees
4. university reputation
5. course content

Task 3. Question related to a given course: what is the initial phase of protein synthesis?

1. Yes, I found the answer.
2. No, I didn't find the answer.

In the second stage, after the completion of the given tasks, the learners are given a questionnaire to obtain indications and feedbacks of the learner experience about the possible constraints and advantages in mobile and desktop learning environment. The questions included in the questionnaire are as following:

1. How satisfied are you with these platforms in mobile/desktop environment? (scaled)
2. How would you describe your experience with the particular device? (excited, happy, normal, angry, frustrated)

3. Was the screen size critical to keep your attention?
4. Is the physical keyboard a factor that influences you to choose between a computer and a mobile device?
5. Was the material easily accessible through a mobile device?
6. Which device/environment is more appropriate to learn with MOOC platforms and why?

The results of our findings will help us to make a comparative analysis of the learning device's impact on learner's experience using MOOCs, i.e. what is the user's feedback or experience while using different devices given various tasks with MOOCs.

4 Results and Discussion

In this section, the experiment results are presented and analyzed for mobile and desktop learning environment. The participants of this study include 90 bachelor students, from four different departments. As many as 44 students are from informatics department, 21 from biology and medicine, and the rest 25 students from the economy department.

Overall, as shown in Fig. 2, the majority of participants (88 %) have a learning experience with MOOCs in a desktop environment, compared to a mobile environment where their experience is minimal.

The graph in Fig. 3 shows five common factors that learners mostly consider when opting for a course of their choice. These factors are course duration, certificate, course fee, university reputation, and course content. Regardless of the

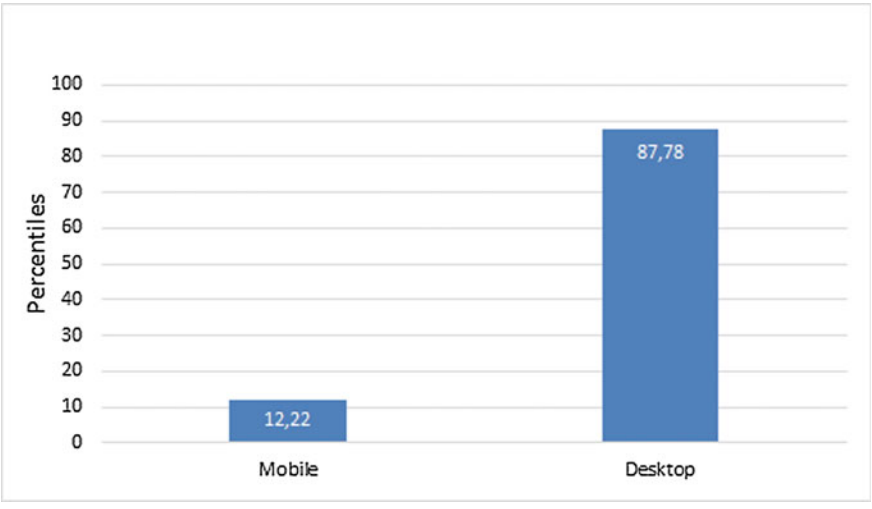


Fig. 2 Learner's experience with MOOCs in mobile and desktop environment

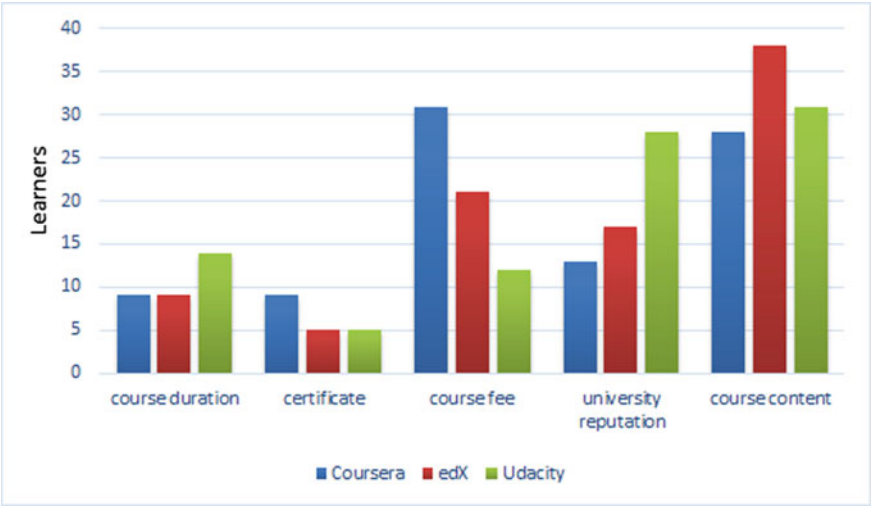


Fig. 3 Reason for selecting a particular course in MOOCs

desktop and the mobile environment, many learners prefer to opt for the course based on the course content and the fee. They usually go for the courses, which are free and provide content they are interested in. Another important factor is the university reputation. If the course offered by a university has a higher reputation than the course fee becomes less relevant. In many cases, the learners even prefer to pay for the given course if they are getting a course completion certification from a reputable institute. The responses against the course fee and the university reputation in the graph reflect this trend.

In response to answering course specific questions, many students found it much easier to find the answers they were looking for in desktop environment, unlike mobile environment. Where about 60 % of the student couldn't locate the information they were supposed to find for the questions given in the experiment task, as shown in Fig. 4. It might be because applications and the mobile site versions of different MOOCs doesn't provide full feature set as they normally have for the desktop versions and thus, it makes it difficult to find the information in the mobile version as compared to the desktop.

On a satisfactory level between 1 to 5, where 1 represents least satisfactory, and 5 represents most satisfactory, learners were most satisfied when finding a given course of their choice and working with different courses in MOOC via their desktop web applications, as shown in Fig. 5.

Students showed mixed emotional behavior on given MOOC platforms. However, the participants were more frustrated and angry when they were accessing MOOC via mobile devices while they were pleased accessing MOOC on the desktop machines, as depicted in Fig. 6. This sort of behavior is most likely because finding relevant information in the mobile environment is not as easy as it

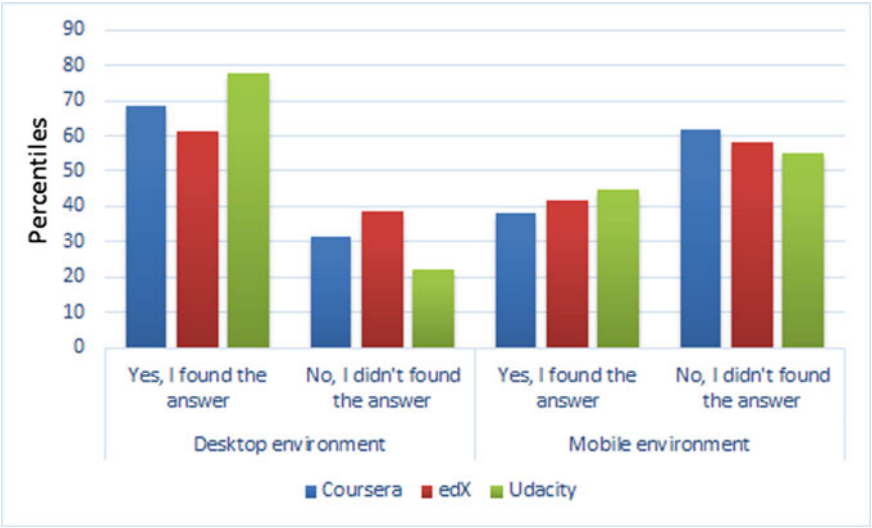


Fig. 4 Answers for course specific question

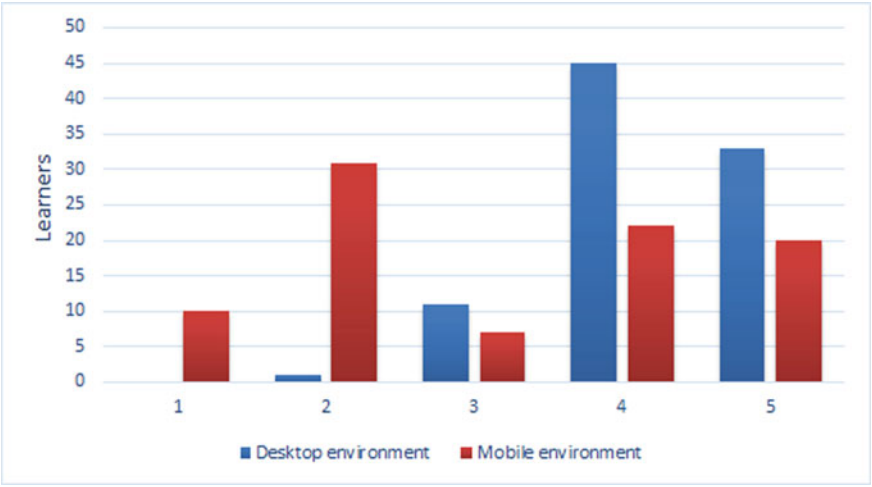


Fig. 5 Learner's satisfactory level with MOOCs in both learning environments

is for the desktop environment. The longer it took them to find the pertinent information, the frustrated and angry they became.

Most participants emphasized that the screen size played a critical role in favoring desktop machines over mobile devices for using MOOC. Partially it has to do with the lack of a physical input device on mobile devices and partially because

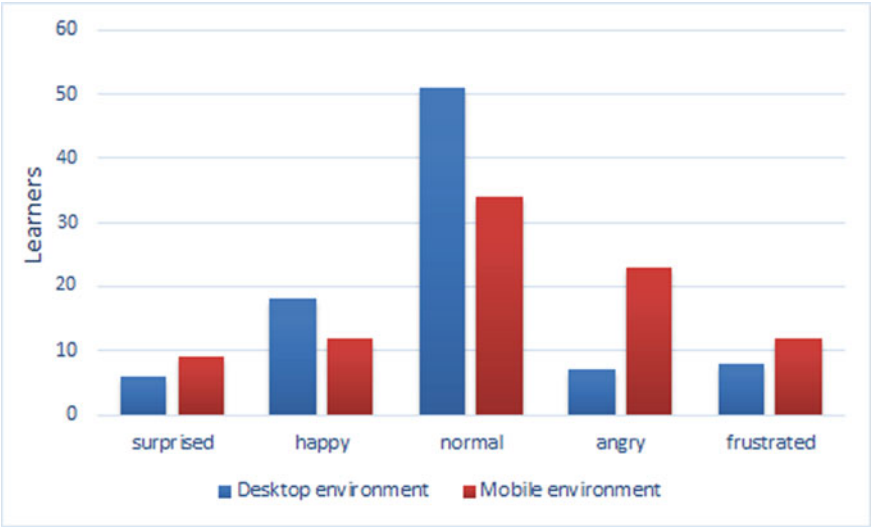


Fig. 6 Learner's emotional feedback while using MOOCs in both environments

it isn't easy to access material through a mobile device. Additionally, participants feel that the desktop machines are more convenient and appropriate when accessing and learning material provided by various MOOC platforms. The feedback is shown in Fig. 7.

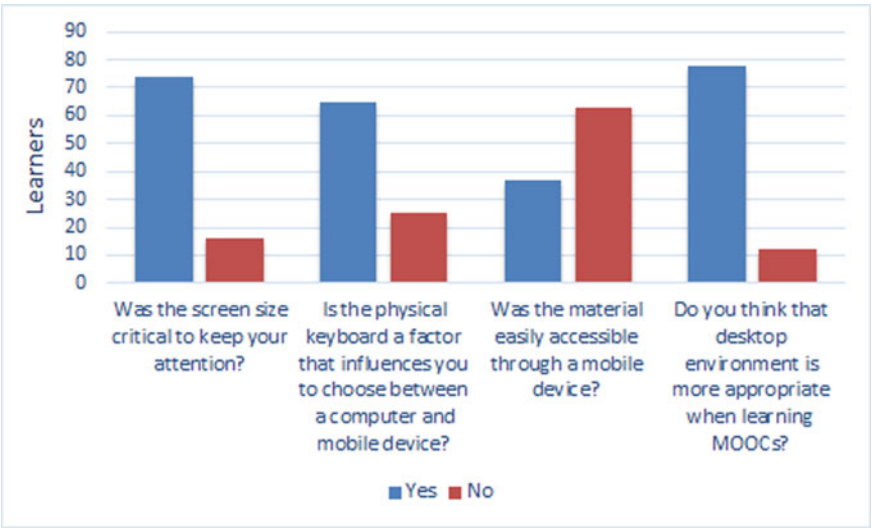


Fig. 7 Learner's feedback after the educational tasks

5 Conclusion and Future Work

Due to the pervasion of mobile technologies, MOOCs platforms are now developing and adjusting courses for access from mobile phones and tablets, adapting to the trend of ubiquitous learning.

The primary goal of this paper was to explore and analyze the learner's experience in desktop and mobile learning environments while performing given educational tasks related to MOOCs. Our analysis shows that the learners face more difficulties with MOOCs tasks in a mobile environment, while preferring mostly to learn in a desktop environment. Moreover, their satisfactory level is much higher in desktop environment. This is because applications and the mobile site versions of different MOOCs does not provide the full feature set as they normally have for the desktop versions.

The paper also investigates learner's emotional behavior while performing educational tasks. As a result, the respondents were more frustrated and angry when they were accessing MOOCs via mobile devices while they were pleased accessing MOOCs on the desktop machines.

As future work, we plan to expand the analysis with a larger pool of learners, review to what extent MOOC platforms have designed courses for mobile versions, and identify the similarities and differences between mobile and desktop versions from the methodological standpoint of e-learning.

References

1. Allison, C., Miller, A., Oliver, I., Michaelson, R., Tiropanis, T.: The web in education. Comput. Netw. **56**, 17 (2012)
2. Espada, J.P., Diaz, V.G., Rodrigues, C.C., Crepo, R.G.: Method for analysing the user experience in MOOC platforms. In: IEEE international symposium on computers in education (SIIE), pp. 157–162 (2014)
3. Pireva, K., Imran, A.S., Dalipi, F.: User behavior analysis on LMSs and MOOCs. In: IEEE conference on e-Learning, e-Management, e-Services, Malaysia, Aug 24–26 (2015)
4. Ozuorcun, N.C., Tabak, F.: Is M-learning versus E-learning or are they supporting each other? Procedia Soc. Behav. Sci. **46**, 299–305 (2012)
5. Low, L., O'Connel, M.: Learner-centric design of digital mobile learning. In: Learning on the Move Conference, Brisbane, Australia (2006)
6. Valderama, B.E.C., Pfleging B., Henze, N., Schmidt, A.: A long-term field study on the adoption of smartphones by children in Panama. In: MobileHCI 2014 ACM Conference, New York, USA (2014)
7. Guler, C., Kilic, E., Cavus, H.: A comparison of difficulties in instructional design processes: mobile vs. desktop. Comput. Hum. Behav. **39**, 128–135 (2014)
8. Bralic, A., Cukusic, M., Jadric, M.: Comparing MOOCs in m-learning and e-learning setting. In: 38th IEEE Convention on Information and Communication Technology, Electronics and Microelectronics (MIPRO), Opatija, Croatia (2015)

9. Marco, F.A., Penichet, V.M.R., Gallud, J.A.: What happens when students go offline in mobile devices? In: MobileHCI 2015 ACM Conference, Copenhagen, Denmark (2015)
10. Renz, J., Staubitz, T., Meinel, C.: MOOC TO GO. In: 10th International Conference Mobile Learning, pp. 125–132, Madrid, Spain (2014)

Part VIII
Leadership Style

Path Model Analysis of Perceived Organizational Support, Job Satisfaction and Turnover Intention: Study on Indian Generation Y Employees

Soumi Rai

Abstract This study attempts to understand the relationship amongst key psychological constructs in the context of Indian Gen Y employees who comprise almost half of the Indian working population and is growing at a rapid pace. Preliminary studies and efforts related to deciphering these young employees have classified them as the most demanding population with high expectations from the work environment in terms of better on-site support facilities and norms for work-life balance. The research proposed to understand the causal relationship between their expectations from organizations (POS) in terms of organizational support and its effect on outcomes related to job satisfaction and turnover intention through a critical analysis and fact finding process. This study indicated Indian Gen Y employees placing more emphasis on organizational support factors that highlight their capabilities and provide tools for advancement.

Keywords Generation Y · India · POS · Young

1 Introduction

Industry today is facing major challenges with managing aspirations and expectations of a diverse workforce, specifically with the inclusion of this happening, demanding and wired Generational cohort termed Generation Y or Millennial. Most researchers believe that each generational cohort experiences almost similar learning processes, growing up around the same time frame with access to similar social, political and economical events during their life progression stages. This process of learning creates a cohort which share similar attitudes, values and perceptions unique to their own generational cohort [5, 8] that in turn can impact organizational practices related to support, work outcomes and commitment levels.

S. Rai (✉)
National Institute of Construction Management and Research (NICMAR),
25/1, Balewadi, N.I.A. Post Office, Pune 411045, India
e-mail: soumirai@gmail.com

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McGuire et al. [18] point out that these differences in learning process of generational cohorts are widely exhibited through their outlook and approach, while ageing employees have high experience levels, maturity, work-orientation and stability; the younger workforce is highly mobile, impatient, and exhibit less organizational commitment but are entrepreneurial, better educated and technologically more competent than previous generations. They further argue that it is these differences in generational cohorts that give way to intergenerational conflicts impacting organizational performance; failure to understand and manage intergenerational conflicts in severe economic situations leads to further complications in terms of lower employee morale, productivity and innovation in turn impacting corporate citizenship resulting in higher employee attrition and turnover.

Theorists have long believed that Human Resource Management (HRM) practices operate through their more proximal influences like Perceived Organizational Support (POS) [21]. Research has summarized that one of the key factors that has an influence on an employee at the Individual level and brings about a significant impact in employee outcomes, attitude and behavior is the relationship between the *organization* and the *employee*. Studies have shown that employees rely on their perceptions of procedural fairness to understand their relationship with the other party specifically related to the aspect of trust in the concerned relationship. The greater an employees' perception of procedural fairness that is if he/she perceives that he has been treated with fairness at each and every step of the processes followed by the other party then are higher chances of strong trust and reciprocal behavior developing in the relationship with the other party. High trust relationship have been shown as positively influencing employee outcome related attitude and behavior like high levels of job satisfaction and lower levels of turnover intention which have been based on the individual's perception of fairness and support (POS) from the organization; an area of interest in the concerned and current study. This study is thus an attempt to link the psychological constructs of Perceived Organizational Support with its consequences Job Satisfaction and Turnover Intention, through a study on Indian Generation Y employees.

2 Indian Generation Y

The term Generation Y refers to a group born from 1982–2000 (hence the term Millennial Generation) who would range in the age groups of 15–29 years identified herein as the young generation. Statistics by the U.S. Census Bureau, estimate that Generation Y comprises of around 25.7 % of the world total population given the age category of 15–29 years. This generation is also at times referred to as the 'Wired Generation' that needs to be connected at all times and feels most comfortable in digital environments. Born and brought up mostly in urban nuclear families, and having early access to communication medium; this generation believes in three major factors, Expectations, Expressions and Acceptance. They are increasingly demanding, wired and virtually connected, questioning traditional

practices cum authority, displaying and openly voicing their disagreements and opinions without paying heed to set cultural norms and organizational practices.

Research work in classification of the Indian generational cohort has generally been limited with initial focus being on generational research in the context of cohorts defined by the western world [3, 13, 14, 22].[1] However in recent years some researchers have attempted to outline generational cohorts in the Indian context with specific reference to social, economical and political changes that have happened in India and their impact of the related generational cohorts. Srinivasan in her research done with 1600 Indian employees classifies Indian employees as per their professional work experiences into Pre-Liberalization (exp > 21 years), Pre-Liberalization (exp between 10–21 years), Rapid growth (exp 5–10 years) and Plateaued growth (exp 0–5 years) (SHRM Report 2012). The research focused on understanding ranking of Instrumental and Terminal values by multi-generational Indian employees. Rajesh and Ekambaram [20] in their study on 250 corporate representative samples in India have classified Indian generational cohorts based on birth years as Veterans (1920–45), Free-Gens (1946–1960), Gen X's (1961–1970), E-Gen's (1971–1980) and Gen Y's (1981–1990).

Research report by Haworth, iDea and Johnson Control on Gen Y and Workplace, 2010 gives a different picture relating to Indian youngsters (Gen Y employees) through their global survey. Indian Gen Y workforce is considered the most demanding population with high expectations from the work environment in terms of better on-site support facilities and norms for work-life balance. They believe in not only socially collaborating but also engaging socially as an extension of their workplace to enhance learning opportunities and maintain a balance between their personal and professional lives. They are strongly influenced by social opinions and base their judgments on peer factors much like their counterparts across the globe. They are a generation tuned to opportunities and consumerism, which make them more open for change, demanding with higher levels of expectations, impacting their perception towards organizations and their engagement processes.

3 Perceived Organizational Support, Job Satisfaction and Turnover Intention

Eisenberger et al. [10] evolved the concept of Perceived Organizational Support (POS) based on the effect-outcome expectancy and the aspect of affective attachment to one's organization based on exchange ideology; an area that was explored by previous researchers [16, 19]. This exchange ideology between the employee

[1]Refer classification of Generations in the Indian Context. Accessed on 24th April 2015 at 2.28 pm from http://www.shrm.org/india/hr-topics-and-strategy/diversity/diversity-initiative-design-and-roll-out/Documents/Employee_Generations_Indian_Workplace.pdf.

and his employer (the organization) seems to have strong impact on job attitudes like organizational commitment, turnover, absenteeism and work-performance for those employees who have strong exchange ideology than on those with weak exchange ideology.

The term 'job satisfaction' refers to the attitudes and feelings people have about their work. Positive and favourable attitudes towards the job indicate job satisfaction. Negative and unfavourable attitudes towards the job indicate job dissatisfaction [2]. The level of job satisfaction is affected by intrinsic and extrinsic motivating factors, the quality of supervision, social relationships with the work group and the degree to which individuals succeed or fail in their work. Job satisfaction can be divided into two elements: intrinsic and extrinsic [6]. Intrinsic job satisfaction refers to the internal state associated with characteristics inherent in a job, such as utilization of skills, the amount of job complexity and opportunity for control, the amount of responsibility and challenges [9]. Extrinsic job satisfaction refers to tangible aspects such as wages, work and benefits. The level of job satisfaction is influenced by a range of intrinsic and extrinsic motivating factors, which include the quality of supervision, social relationships with work groups and the degree to which individuals fail or succeed in their work. Research on Job satisfaction has been explored through its relationship with various facets like pay, supervision, quality of work life, performance improvement and organizational commitment. Researchers have found significant correlations of job satisfaction with pay, work organization and work conditions [7, 15, 17, 25].

Turnover intent is defined as the reflection of, "*the (subjective) probability that an individual will change his or her job within a certain time period*" [24] and is an immediate precursor to actual turnover. Although research has looked at understanding both actual turnover and turnover intention in separate studies, it has been found that the factor of actual turnover is influenced by turnover intention and as turnover intention increases, actual turnover also increases. Studies related to turnover intention have focused on both economical and psychological factors that affect this intention in employees, however the focus from the psychological school of research has been found to be stronger with aspects of Job satisfaction, Organizational Commitment, Psychological contract having impact on employees' perceptual process in turn increasing or decreasing his or her intention to either leave or continue participation in the organization.

There has been a lot of debate in literature to the similarities that may exist between Perceived Organizational Support (POS) and Job Satisfaction as most people seems to understand that both may be similar in perspective. However evidence based research by POS theorists distinguish POS and Job Satisfaction; Shore and Tetrick [23] illustrate that while POS has been conceived as a descriptive belief about the organization and relates to the '*humane* aspect of the organization in long term perspective, job-satisfaction is understood to be an affective-laden attitude. They argue that overall job satisfaction is more subject to recent changes in job conditions than POS which has a more long term perception and not purely based on conditions of the job wherein organization may have little control. To illustrate this with an example, [11] outline that if pay raise happens due to some

legal regulation (wherein organization has no control) it may increase overall job satisfaction and vice versa if pay is reduced by organization due to financial difficulties, it may reduce overall job satisfaction but it will not impact POS to a great extent as employees' understand that organization has limited control over market financial conditions hence while they may not be too satisfied with their job they may still be committed to the organization due to positive perception of organizational support. At best they feel more obliged to the organization not retrenching them during hard times and adjusting with some pay cuts in the long run.

Social exchange theory [4] and Organizational support theory [10] outline that employees who receive high levels of support from the organization are inclined to repay the organization. One essential way to reciprocate the organization's favorable treatment is through continued participation [1, 27]. POS research provides some evidence in support of this proposition. The negative relationship between POS and turnover intention was also evident in some other studies (e.g., [12, 27]). Rhoades and Eisenberger [21] concluded that desire to remain with an organization had a large, positive relationship with POS.

This research work thus makes an attempt to understand the differentiating relationship between the constructs of POS and Job satisfaction in the context of Indian Generation Y employees and its further effect on Turnover Intention. Since seminal research work on Consequences of POS have been conducted in the western countries, attempt herein is to understand if this construct does have an impact on a demanding Indian Generational cohort where 'Expectations' are a key cohort characteristics and how much does it have an effect on their desire to continue with their organizations.

4 Research Model and Design

Outlining of the proposed concept was initiated with designing of a proposed model. The objective thereby was to design the Survey Instrument in line with the objectives of the research work and validate the outcomes through use of Structural Equation Modeling. This research work is a part of the doctoral research study that was conducted on Indian Generation Y employees related to understanding impact of Work Values on POS and Job Attitudes.

The research criteria for this survey was a clear demarcation of the working population according to the age criteria of 20–30 years having a minimum work experience of 1 year irrespective of the sector of employment or the level of employment. A total of 337 respondents across various work sectors of Pune city, filled the online and offline (hard copy) survey instrument. After elimination of some half-filled survey forms, the final respondent tally stood at 320 fully filled survey forms. In terms of Gender composition, of the 320 survey respondents 251 respondents were male and 69 respondents were female. Of the 320 respondents, majority of the respondents had a work experience of 2–4 years (142 respondents), followed by 1–2 year (136 respondents) with 34 respondents having a

work-experience of 5–8 years and only 8 respondents having a work-experience in the 8–10 years range.

The Survey Instrument was developed on an online platform of Google docs based on Standardized pre-tested versions; Perceived Organizational Support by Eisenberger et al. [10] and Rhoades and Eisenberger [21] and Job Satisfaction & Turnover Intention by Warr et al. [26]. The respondents were mailed the link to the Survey Instrument enabling them to respond to the survey outside the organizational settings through their personal internet connectivity. The link was sent to the respondents only after verification of research criterion fulfillment related to location, age categorization and minimum work experience level.

5 Results

Reliability analysis for each construct gave value about 0.7; Perceived Organizational Support (0.84), Job Satisfaction (0.85) and Turnover Intention (0.73). This indicated that the survey instrument is reliable and can be applicable in the context of Indian Generation Y employees. Perceived Organizational Support comprised of 10 items while Job Satisfaction has 6 items and Turnover Intention comprised of 3 items in the scale. Exploratory factor analysis was conducted through Principal component analysis with varimax rotation at eigen value 1. Each main construct and its sub-constructs were represented by different items in the questionnaires. Clear representation of the factors and their loading are given below for understanding. It was decided that for each sub-construct, the highest loading factor (above 0.75) would be considered for further analysis. This gave an understanding about factors which were considered most important and effective by the respondents (Table 1).

Table 1 Mean values and factor loadings

Construct Items	Mean	Factor loadings	Construct items	Mean	Factor loadings
P1	3.71	0.595	J1	3.48	**0.808**
P2*	2.97	0.802	J2	3.63	0.715
P3	3.28	0.602	J3	3.62	**0.781**
P4*	3.36	0.864	J4	2.97	**0.764**
P5	3.29	0.608	J5	3.46	**0.779**
P6	3.32	0.742	J6	3.3	0.721
P7	3.41	0.689	T1	3.22	**0.874**
P8	3.09	**0.821**	T2	2.56	**0.843**
P9	3.37	**0.768**	T3	2.84	0.717
P10	3.4	**0.774**			

*Correlation is significant at the 0.05 level (2-tailed)

In terms of analysis of descriptive, the mean value for item P1('Organization values my contribution to it's well being) was highest, at 3.71, implying that respondents perceive that their contribution to their respective organization is highly valued hence the level of response is highly favorable for this particular item. Similarly scale items P7 ('The organization takes pride in my accomplishments at work') and P10 ('The organization is willing to extend itself in order to help me perform to the best of my ability') also have higher mean values of 3.41 and 3.40 respectively, implying that Gen Y employees give a lot of importance to the '*me*' factor in terms of their perception of organizational support. However in the context where responses are related to the organization like scale items P8 ('The organization strongly considers my goals and values') and P2 ('The organization fails to appreciate an extra effort by me'), the mean values are lower at 3.09 and 2.97 respectively; indicating that Gen Y employees perception of organization giving consideration to their goals and appreciating their work is less favorable. It is important to note that in the context of scale item P2, the scoring has been reversed; i.e. it is a reverse scoring item of the POS scale. Reverse scoring questions have been marked with *.

Scale items J2 ('I find my work challenging and interesting') and J3 ('the work environment provides support and tools for doing work') score higher mean values of 3.63 and 3.62 respectively, implying that Gen Y employees derive Job satisfaction from both intrinsic and extrinsic factor i.e. challenging work (intrinsic) and work environment (extrinsic). The lowest mean value are attributable to items J6 ('I intend to grow within this organization and get better opportunities of advancement') and J4 ('I am satisfied with the way this organization is managed') at 3.30 and 2.97 respectively. Also the standard deviation of scale items J6 and J4 are quite large, implying that there seems to be a huge variation amongst respondents on these particular items. This shows that while respondents find confidence in their personal/individual aspect of satisfaction stemming from intrinsic or extrinsic variables, their responses related to organizational context and satisfaction with organizational systems lack confidence; hence the huge variation in data.

The highest mean value on this scale is attributable to scale item T1 ('I intend to stay in this organization for the next 1 year') at 3.22. Given the volatile business environment globally and the characteristics of both global Gen Y employees and specifically Indian Gen Y employees,[2] a higher mean value for this particular item should be a welcome sign for organizations in terms of employee stability; most respondents seem to agree on continuing for at least 1 year with their current organizations. However the author believes that had this item question be posited differently, i.e. an extension to 5 years instead of 1 year—the responses may have been quite different. Scale item T2 ('The thought of leaving this company has not occurred to me') shows lowest mean value at 2.56, implying that most respondents have either been contemplating or plan to contemplate on the thought of continuing or not continuing with their current organizations; the thought is very much

[2]Refer to section on Gen Y and Indian Gen Y in Literature review of the study.

prevalent in their minds but may not have materialized based on opportunities existing in the outside business environment. Variation in the responses based on large standard deviation implies that Gen Y employees are inconsistent on their desire to continue with their current organizations.

In terms of inter-item correlations, all items of the 3 constructs—Perceived Organizational Support, Job Satisfaction and Turnover Intention show significant relationships indicating that any changes in one construct will have an effect on the other constructs. Path Analysis of the hypothesized research model was conducted through use of AMOS version 18. Measurement Models A, B and C were created with Measurement Model A depicting the constructs of POS (Perceived Organizational Support) and TI (Turnover Intention); and Measurement Model B depicted the constructs of Job Satisfaction and Turnover Intention while Measurement Model C added the mediating construct of Job Satisfaction to understand if there is any change in effect due to this particular variable on the aspect of Turnover Intention. Structural Models were thereafter created for the measurement models to confirm the casual effects of the variables. Structural Model C is the final model depicting all 3 constructs of the concerned study. The model was modified with creation of a relationship path between T2 ('the thought of leaving this company has not occurred to me') item of the TI scale and J3 ('the work environment provides support and tools for doing work') item of the JS (Job Satisfaction) scale. Analysis of the models has been discussed at length below (Tables 2 and 3).

Table 2 Correlation statistics

	P8	P9	P10	J1	J3	J5	T1
P9	0.611**						
P10	0.607**	0.607**					
J1	0.422**	0.291**	0.373**				
J3	0.369**	0.325**	0.362**	0.54**			
J5	0.339**	0.32**	0.27**	0.531**	0.528**		
T1	0.276**	0.261**	0.295**	0.522**	0.423**	0.482**	
T2	0.262**	0.364**	0.297**	0.521**	0.353**	0.511**	0.644**

**Correlation is significant at the 0.01 level (2-tailed)

Table 3 Comparison of model fit indices

	χ^2/df	RMSEA	GFI	CFI	TLI	NFI	PNFI	PCFI
Model A	2.16	0.06	0.98	0.99	0.97	0.98	0.39	0.39
Model B	1.28	0.03	0.99	0.99	0.99	0.99	0.29	0.3
Model C	1.57	0.04	0.98	0.99	0.98	0.97	0.55	0.56

6 Discussion

POS and JS are both related to discretionary aspects of the job and based on the premise of Social exchange theory. Researchers working on these constructs have clearly outlined how both POS and JS differ in terms of employee outlook towards circumstances within organization's control and job conditions [11, 23]. POS in the context of this study indicated Indian Gen Y employees placing more emphasis on organizational support factors that highlight their capabilities and provide tools for advancement; however in the context of organizational support related to alignment of personal goals with organizational goal and recognition, the responses are varied. Similarly in the context of JS, Indian Gen Y employees exhibit more satisfaction towards the job support tools and the work itself; however in the context of organizational support for career advancement, intention to grow in the organization and outlook towards better management of the organization, responses are varied. This indicates that for Indian Generation Y employees the Perception of Organizational Support is lower in terms of understanding and support by their respective organizations towards career advancement, alignment of personal goals and organizational systems related to better management of employee development practices. There is a lack of confidence amongst this young cohort towards organizational policies and practices towards career advancement and growth opportunities within the current organization. So while this study aligns with previous research work on POS and JS being positively and significantly related; it differs on the parameters of perception towards Organizational Support related to certain intrinsic and extrinsic factors that Indian Gen Y employees believe are within the control of the organization but are currently not being better managed by their respective organizations. Viewed from their perspective this also displays a lack of confidence towards management (leadership) thought process in terms of engaging and retaining this generational cohort.

The evidence of Indian Gen Y's employee lack of confidence towards Organizational Support in the context of aligning their personal goals and availing them career advancement within the organization is further strengthened with the relationship analysis of POS and TI. Research on the relationship between POS and TI have looked at mediating roles of other psychological constructs in the study like Affective commitment and Job Satisfaction, however most of the research work [1, 27] indicate that with increase in POS, the intention to continue with the organization increases while the intention to leave the organization decreases; that is POS and TI should have a inversely proportional relationship.

Interestingly the outcome of this study exhibits a proportional, positive but significant relationship between the construct of POS and TI. This indicates that with an increase in support from the organization, the intention to turnover is increasing; indicating a diversion from previous research work. Furthermore with introduction of the third construct JS (Job satisfaction) as a mediator variable the indirect effect between POS and TI, mediated by JS increases to 0.471 which is attributable to a strong, positive and significant relationship. This challenges the

prevalent notion of POS as propounded by Eisenberger et al. [12] wherein increase in POS is understood to have an inverse impact on Turnover Intention. Even JS as outlined above should demonstrate an inversely proportional relationship with TI in terms of direct effect. However acting as a mediator variable JS tends to increase the strength of the positive or proportional relationship between POS and TI which is a variation from previous research work done on these 3 very important psychological constructs.

A point to note here would be the item questions that have been considered by the study for Turnover Intention; these relate to staying with the organization for at least one year (T1 = "I intend to stay with this organization for at least one year") and to the consideration of not leaving the organization (T2 = "The thought of leaving the company has not occurred to me"). In this light and considering that the survey has been conducted on Generation Y employees in the age group of 19–29 years, the indirect and positive relationship between Perceived Organizational Support and Turnover Intention indicates that this cohort does not seriously give consideration to the aspect of either being committed to the organization for more than a year or ever giving a serious thought to continuing with the organization in the long term. Their perception is strongly based on '*NOW*' or the aspect of instant gratification which is understood to be a strong characteristic of this particular cohort. Their outlook and thought process is more in the present than in the future, specific characteristics being attributable to their demanding nature and more reliance on extrinsic factors. They prefer to live in the moment, enjoy their lives and not be much concerned about the future, but would be open to leaving at the first available career opportunity that is viable and makes sense for their personal growth in life. This indication is in line with the transactional nature of the relationship between Gen Y employees and their respective organizations as indicated earlier in the study.

7 Conclusion

Analyzing Indian Gen Y employees under the reciprocal relationship framework (social exchange); indicated that this cohort expects their Organizations to not only support them in terms extrinsic factors but also intrinsic factors, ensuring challenging work is availed to them and they are reciprocated for their productivity through rapid career advancement and growth opportunities within the organization. They believe that their organizations need to have clear career advancement programmmes that are better managed, visible and avail tangible results. Their intention to continue or not continue with their organizations is very much grounded in the current context which can vary based on how their view changes of POS and Satisfaction to the work itself.

The aspect of being able to express their opinions (*Expression*); and having their ideas being valued and recognized (*Acceptance*) hold a higher level of importance for this category of employees. This is evident through their higher presence on

social media platforms wherein they seek to share ideas, collaborate and grow both individually and as a group. Transparency in organizational procedures and clear communication channels where opinions are considered and merited is high on Indian Gen Y agenda in terms of improvements expected in organizational support. This generation believes more in expressing their ideas/opinions and want their potential to be recognized by their leaders (supervisors); thus growing by availing opportunities of mutual development.

Generation Y employees are highly impatient and look towards instant gratification in terms of results. Routine work and long hours bring monotony in their jobs and lack of involvement in activities other than work takes a toll on their strong desire for work-life balance. Actually this generation is kind of 'wants it all' and 'in very short time'; also know for 'wearing their heart on their sleeves'. Work stress and early work fatigue can be a resultant effect of their perception of work monotony, leading to lower productivity and lack of motivation. Being a generation more tuned to the transactional aspect of work, it is imperative to deal with these cohort employees by availing those activities other than work where they feel they are making a meaningful contribution.

Organizations need to understand how much this generational cohort values expression and acceptance of their ideas/opinions. Even if they are not workable or applicable; at least giving them a platform to put their ideas/opinions forward is also understood as support. They need to be told in logical terms why and how their ideas are not workable but can be if improved; they are more than willing to put in dedicated efforts to ensure that they are committed towards enhancing and improving the same. For this generation, it is very important to be heard, appreciated and considered. They do not like to dealt like other employees wherein they only give productivity without understanding what exactly they are working for and how is their productivity going to be valued by the organization. They want to know at each stage, where is the organization going and what can they do for mutual development. Hence it is important to keep Gen Y employees involved in team decision process, idea sharing and initiatives that challenges their intellect; this will ensure that they feel worthwhile in the team and deem this as a crucial parameter of support and recognition by the organization.

It is important to understand that while this cohort is willing to reciprocate the support given by their organizations in the current context by being highly committed and obliged to the organization; it does not necessarily translate into long term employment or reduced turnover intention for the cohort. The reciprocal relationship is purely based on availability of support and opportunities in the current context; given a better option employees of this cohort will not shy away in leaving their current organization. Being a generational cohort that gives more value to the present context than past context, and is impatient in its decision making process; what matters is the level of opportunity available and not necessarily the aspect of organizational support, obligation or commitment that dictates whether they intend to continue or not with the same organization. This cohort is at peace taking sudden decisions wherein they feel that the current opportunity is worthwhile and viable than the aspect of continuation with the same organization.

Hence organizations need to keep them engaged and involved at each and every stage of their work life through various initiatives to avail commitment and productivity.

References

1. Allen, D.G., Shore, L.M., Griffeth, R.W.: The role of perceived organizational support & supportive human resource practices in the turnover process. J. Manag. **29**, 99–118 (2003)
2. Armstrong, M.: A Handbook of Human Resource Management Practices, 10th edn. Kogan Page, London (2006)
3. Bijapurkar, R.: Winning in the Indian Market: Understanding the Transformation of Consumer India. Wiley, Singapore (2007)
4. Blau, P.: Exchange and Power in Social Life. Wiley, New York (1964)
5. Bogdanowicz, M.S., Bailey, E.K.: The Value of Knowledge & the Values of the New Knowledge Worker, Generation X in the New Economy. J. Eur. Indus. Training **26**(2–4), 125–129 (2002)
6. Clark, A., Oswald, A., Warr, P.: Is job satisfaction U-shaped in age? J. Occup. Organ. Psychol. a **69**(1), 57–81 (1996)
7. Cohen, S., Bailey, D.: What makes teams work, group effectiveness research from the shop floor to the executive suite. J. Manag. **23**(3), 239–290 (1997)
8. Costello, B., Lenholt, R., Stryker, J.: Using blackboard in library instruction, addressing the learning styles of generations x & y. J. Acad. Librariansh. **30**(6), 452–460 (2004)
9. Cowin, L., Johnson, M., Craven, R., Marsh, H.: Causal modeling of self concept, job satisfaction, & retention of nurses. Int. J. Nurs. Stud. **45**(10), 1449–1459 (2008)
10. Eisenberger, R., Huntington, R., Hutchinson, S., Sowa, D.: Perceived organizational support. J. Appl. Psychol. **71**(3), 500–507 (1986)
11. Eisenberger, R., Cummings, J., Armeli, S., Lynch, P.: Perceived organizational support, discretionary treatment & job satisfaction. J. Appl. Psychol. **82**(5), 812–820 (1997)
12. Eisenberger, R., Armeli, S., Rexwinkel, B., Lynch, P.D., Rhoades, L.: Reciprocation of perceived organizational support. J. Appl. Psychol. **86**(1), 42–51 (2001)
13. Generational differences between Indian and the U.S. (Erickson 2009) https://hbr.org/2009/02/global-generations-focus-on-in
14. Ghosh, R., Chaudhari, S.: Intergenerational differences in individualism/collectivism orientations: implications for outlook towards HRD/HRM practices in India and the United States. New Horiz. Adult Educ. Hum. Res. Dev. **23**(4), 5–21 (2009)
15. Harley, B.: The myth of empowerment, work organisation, hierarchy & employee outcomes in contemporary Australian workplaces. Work Employ. Soc. **13**(1), 41–66 (1999)
16. Levinson, H.: Reciprocation: the relationship between man and organization. Admin. Sci. Q. **9**, 370–390 (1965)
17. Maertz, C., Griffeth, R.: Eight motivational forces & voluntary turnover, a theoretical synthesis with implications for research. J. Manag. **30**(5), 667–683 (2004)
18. McGuire, D., Todnem, R.B., Hutchings, K.: Towards a model of human resource solutions for achieving intergenerational interaction in organisations. J. Eur. Indus. Training **31**(8), 592–608 (2007)
19. Mowday, R.T., Porter, L.W., Steers, R.M.: Employee-organization linkages: the psychology of commitment, absenteeism, & turnover. Academic Press, New York (1982)
20. Rajesh, S., Ekambaram, K.: Generational diversity in the Indian workforce: an Exploratory study. Int. J. Manag. Stud. Res. **2**(7), 54–64 (2014)
21. Rhoades, L., Eisenberger, R.: Perceived organizational support, a review of the literature. J. Appl. Psychol. **87**, 698–714 (2002)

22. Roongrerngsuke, S.: Attracting and retaining multigenerational workforce in China, India and Thailand. In: SHRM Annual Conference, 2010 presentation, http://sapphire.shrm.org/annualconferenceondemand/2010-annual-conference/6292010-attracting-retaining-multigenerational-workforce-china-india-thailand.aspx (2010)
23. Shore, L.M., Tetrick, L.E.: A construct validity study of the survey of perceived organizational support. J. Appl. Psychol. **76**, 637–643 (1991)
24. Sousa-Poza, A., Henneberger, F.: Analyzing job mobility with job turnover intentions, an international comparative study. Res. Inst. Labour Econ. Labour Laws **82**, 1–28 (2002)
25. Taplin, I., Winterton, J.: The importance of management style in labor retention. Int. J. Sociol. Soc. Policy **27**(1/2), 5–15 (2007)
26. Warr, P., Cook, J., Wall, T.: Scales for the measurement of social work attitudes and aspects of psychological. J. Occup. Psychol. **52**, 129–148 (1979)
27. Wayne, S.J., Shore, L.M., Liden, R.C.: Perceived organizational support & leader-member exchange, a social exchange perspective. Acad. Manag. J. **40**, 82–111 (1997)

Charismatic Influence and Organizing Capability as Unique Managerial Self-efficacies for Effective Small Firm Performance in Developing Economy

Mohammed-Aminu Sanda

Abstract In the past two decades, changes in the industrial environment of most developing countries and the increasing competition among firms has greatly influenced executives' attitudes and behaviours in the effective management of their firms. There is evidence in the extant literature that the sustained superior performances of most firms is attributable to the unique capabilities used in managing their human resources, and which capabilities are rare, valuable, non-substitutable and imitable. This study therefore, explored the requisite self-efficacies that are exhibited by executives of small firms in Ghana in their day-to-day management of their businesses that leads to increase firm performance, since such self-efficacies are human-oriented capabilities that are rare, valuable, non-substitutable and imitable. This was necessitated by the observation that most executives of small firms in Ghana have not been able to achieve much for their firms, in terms of increasing their businesses productive efficiencies and effectiveness, because the requisite self-efficacies required of such executives for improved performances are unknown and unexplored. Guided by the self-efficacy theorization, data was collected from executives of seventy-two small firms in Ghana using a standardised questionnaire. Factor analysis was conducted to identify the plausible factors with the requisite weight to predict the executives' self-efficacy, and the attribution of such factors. The factor analyses, with Kaiser-Meyer-Olkin as well as Bartlett's tests, were initiated to measure the factorability of the data, using the statistical package for the social sciences (SPSS) as the analytic tool. Principal Component Analysis was then used as a data reduction technique using the Rotation Method (Varimax with Kaiser Normalization). Indicator predictiveness was interpreted using Schumacker and Lomax's (2004) recommendation that estimated factor loading must be 0.7 or higher. Based on the analysis, it is found that the executives of small firms in Ghana exhibit self-efficacies which they manifest variously as charismatic influences and organizing capabilities. The executives showed high levels of organizing capabil-

M.-A. Sanda (✉)
University of Ghana Business School, P.O. Box LG 78, Legon, Accra, Ghana
e-mail: masanda@ug.edu.gh; mohami@ltu.se

M.-A. Sanda
Luleå University of Technology, 97187 Luleå, Sweden

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ities and charismatic influences on the work they manage as a result of their self-efficacies. It is also found that the self-efficacy indicators reflecting the executives' exertion of charismatic influences on their employees correlated significantly with their self-efficacy indicators reflecting their capabilities to organize their firms' activities. It is concluded that the executives' use of their charismatic influence-oriented and organizing capability-oriented self-efficacies has a positive influence on their abilities to manage their small firms. It is also concluded that, the executives ability to handle the time demands and the paper work required of their managerial jobs, on the one hand, and their ability to maintain control of their personal daily schedule, and cope with the stress aspect of their managerial job, on the other, had a direct positive impact on their abilities to carry out the following functions. The findings in this study contribute to knowledge in the management of small firms. Specifically, for Ghana, this research provides a platform for the development of a database that will help inform policy-makers on the requisite self-efficacies to be required of small firms' executives in the daily management of their businesses.

Keywords Small firm · Executives · Managerial self-efficacy · Charismatic influence · Organizing capability · Ghana

1 Introduction

In the past two decades, changes in the industrial environment of most developing countries and the increasing competition among firms has greatly influenced executives' attitudes and behaviours in the effective management of their firms. Ulrich and Lake [27], has attributed the sustained superior performance of most companies to unique capabilities for managing human resources to gain competitive advantage. Barney [4, 5] has also posited that the basis for a firm's sustained competitive advantage is comprised of its organizational resources and capabilities that are rare, valuable, non-substitutable and imitable. This resource-based view of the firm suggests that a firm's competitive advantage is sustained by its human resource system through the facilitation of its specific competence development. Several studies (e.g. [6, 20, 31]) have shown that firms use the specific competences developed to manage the complex social relationships that are embedded in their history and culture towards the generation of tacit organizational knowledge. The resource-based view of organizational strategy and competitive advantage has therefore had a significant influence on a number of theoretical and empirical efforts in several studies (e.g. [1, 5, 9, 14, 16, 17, 20, 21, 29]).

A study of the competences exhibited by executives of small firms in Ghana [22] have shown that most of them have over the year not been able to achieve much for their firms, in terms of increasing their businesses productive efficiencies and effectiveness, because the requisite self-efficacies required of such executives for improved performances are unknown and unexplored. In other words, executives of

small firms in Ghana may not have been able to achieve much in terms of competitive advantage because the self-efficacies required of such executives to make their business become highly competitive continues to pose a challenge.

This study was therefore conducted with the purpose of identifying the requisite self-efficacies that are exhibited by executives of small firms in Ghana in their day-to-day management of their businesses. In this respect therefore, this study was guided by the following three research questions; (i) what are the indicators of self-efficacy exhibited by executives of small firms in Ghana towards effective managerial performance at work? (ii) Do the indicators of self-efficacy exhibited by executives of small firms have the same or different attributes? (iii) If the attributes are to be different, is there an influential relation among the different indicators?

2 Literature Review

The concept of self-efficacy is derived from social learning theory and refers to a person's belief in his or her capability to perform a particular task [3]. According to Wood and Bandura [30], self-efficacy is indicative of the belief that a person has in his/her capabilities to mobilize the motivation, cognitive resources and courses of action needed to meet given situational demand. Self-efficacy as a construct is conceived by Bandura [2] as one's judgement of ability to execute an action, and is therefore a largely perceived construct which has been established as a reliable predictor of a wide variety of goal-directed behaviours. Based on this perspective, Gist and Mitchell [13] found self-efficacy to be based upon a person's past experience and anticipation of future obstacles and which affects that person's beliefs about whether specific and desired goals are attainable or not. According to Boyd and Vozikis [7], if a person's self-efficacy is low, he or she will not act, even if there is a perceived social approval for that behaviour. Decades of empirical research have generated a great number of studies in clinical, educational, and organizational settings which posited the positive relationship between self-efficacy and different motivational and behavioural outcomes [2, 3, 25]. Self-efficacy, as a concept, provides an eclectic extension of the traditional motivational approaches. Based on its predictive power and strong relationship with work performance [25], self-efficacy has considerable implications for understanding and harnessing entrepreneurial behaviour [28]. Several entrepreneurship theorists (such as, [7, 23]) have proposed that self-efficacy plays an influential role in the new business creation process. For example, Boyd and Vozikis [7] proposed that self-efficacy influences the development of entrepreneurial intentions and hence the probability of venture creation. Boyd and Vozikis [7] argue that a person's intention to start a business is formed in part by the person's perception about the anticipated outcome. In other words, few people will wish to engage in entrepreneurial activities if they believe there is a high probability of failure [7]. Conversely, a person will wish to create a new business or act upon an existing entrepreneurial intention, only when

that person's self-efficacy is high relative to the perceived requirements of the specific opportunity [7].

According to Chen et al. [8] entrepreneurship self-efficacy is the strength of a person's belief that he/she is capable of successfully performing the various roles and tasks of entrepreneurship. Thus, self-efficacy is positively related to one's intention in setting up a business [8]. High levels of self-efficacy are associated with strategic risk taking [15]. In this regard therefore, self-efficacy is a critical antecedent of entrepreneurial intent [15]. According to Krueger and Brazeal [15], persons with high self-efficacy have more intrinsic interests in entrepreneurial tasks, and are also more willing to make an effort and show persistence when faced with obstacles and setbacks. According to Cox et al. [10], entrepreneurial self-efficacy develops over time and is influenced by a number of external and internal factors, such as upbringing, economic circumstances, personality and values. Mueller and Goic [19] also viewed entrepreneurial self-efficacy to be affected by both national and regional context to the extent that opportunities for a person to gain confidence through experience and role modelling can be prevalent or limited. Prevalence of such opportunities will enhance a person's self-efficacy while limitation to such opportunities will reduce a person's self-efficacy [19].

Since efficacy judgments are task specific and regulate behaviour by determining task choices, effort and persistence, self-efficacy facilitates task performance particularly early in the learning process [26]. By implication, self-efficacy beliefs emphasize an assessment capability as opposed to a concern with outcome [25]. This means that a person's self-efficacy influences the effort he/she puts in a task and how long he/she persists in doing the task. Thus if a person believes that the performance of a certain task is within his/her capability, it is likely that such person will pursue the task, irrespective of the level of difficult given the belief in self. In this respect, therefore, self-efficacy can be seen as mediating entrepreneurial intentions [32].

Therefore, in order to understand and apply self-efficacy effectively, especially how the construct can be incorporated more fully into entrepreneurship, these subtle differences must be understood [28]. Although Bandura [2, 3] reasoned that self-efficacy influence is partially socially constructed and that such construction may differ as a function of national culture, little direct evidence exists that may connect cultural values to self-efficacy [28]. According to Earley [12], self-efficacy is influenced by different sources of information that are more or less persuasive depending on a person's cultural values. This observation, in the view of Urban [28], suggests that a cultural contingency approach is needed for research on self-efficacy.

In the view of Mueller [18], entrepreneurial self-efficacy can be a useful measure of the strength of an individual's belief that he or she is capable of successfully performing the tasks of an entrepreneur. Since entrepreneurship entails mix and sequential tasks related to creating and growing a new business venture as it has been argued by some scholars (e.g. [11, 19]), identifying specific entrepreneurial

tasks is challenging. Several studies (e.g. [8, 11, 19, 24]) have attempted to define entrepreneurial tasks as a basis for measuring entrepreneurial self-efficacy. For example, Mueller and Goic [19] defined entrepreneurial tasks within a process model framework whereby an entrepreneurial activity is separated into four discrete phases. In the first phase, the entrepreneur develops a unique idea and/or identifies a special opportunity by drawing upon his/her creative talents and the ability to innovate [19]. The second phase consists of activities which enable the entrepreneur convert his/her ideas into a feasible business plan that addresses issues such as, product specifications, market size, start-up costs, operating costs, business location, and identifying required resources for sustainable growth [19]. The third phase entails the assembling of required resources, such as capital, labour, customers and suppliers needed to bring the business into existence [19]. During the fourth phase, the entrepreneur must act as an executive-level manager by managing various business relationships, solving problems quickly and efficiently, engaging in strategic planning, and applying sound management practices [19].

3 Methodology

3.1 Population and Sampling

The target population of this study were executives of small firms in the Accra metropolis (i.e. the capital of Ghana), with each executive having a known chance of being represented on the target sample. Convenience sampling method was employed to draw 100 respondents (i.e. executives of small firms) to whom the standardised self-completion questionnaire was administered.

3.2 Procedure for Data Collection

A standardised self-completion questionnaire entailing managerial self-efficacy items developed by Kagire and Munene (2007) was used as the data collection tool. The questionnaire was used to measure self-efficacies as adapted by Kagire and Munene (2007). The rating scale response followed the four-point Likert scale from rarely (1) to very often (4). In the data collection approach, the questionnaires were handed over to each respondent by the researchers. The respondents were the executive's small firms in the Accra metropolis of Ghana. The researcher had to explain the purpose of the study to the respondents and guaranteed their anonymity and confidentiality of the information obtained. The data collection period was three months (i.e. from January, 2015 to March, 2015).

3.3 Procedures for Data Analysis

A stepwise approach was adapted to the analysis. The first step was to undertake a descriptive statistical analysis to establish the distribution of the demographic characteristics of the respondents. Factor analysis was conducted to identify the plausible factors with the requisite weight to predict the executives' self-efficacy, and the attribution of such factors. Factor analysis aimed at establishing whether all the self-efficacy indicators measure the constructs of interest satisfactorily. The factor analyses, with Kaiser-Meyer-Olkin as well as Bartlett's tests, were initiated to measure the factorability of the data, using the statistical package for the social sciences (SPSS) as the analytic tool. Principal Component Analysis was then used as a data reduction technique using the Rotation Method (Varimax with Kaiser Normalization). Indicator predictiveness was interpreted using Schumacker and Lomax's (2004) recommendation that estimated factor loading must be 0.7 or higher.

4 Results and Discussion

4.1 Demographic Assessment of Study Participants

Of the 100 questionnaires administered, 72 were returned (72 % response rate) with all sections fully scored. The demographic characteristics of the respondents showed that there were more male respondents (68 %) than female respondents (32 %). Majority of the executives are in their middle-ages. In this regard, 24 (33 %) of the respondents have their ages ranged between 30 and 39 years, while 22 (31 %) of them are aged between 40 to 49 years. A significant number of them (29 %) are also in their prime ages (i.e. 20 to 29 years). Only a few of them (7 %) are above 50 years of age.

Generally, the executives are adequately educated as it is reflected by the distribution of the highest level of education they have acquired. Majority of the executives (50 %) are university graduates, with 27 (37 %) of them being first degree holders, and 13 (18 %) of them holding degrees up to the postgraduate level. Twelve (17 %) of the executives are diploma holders while 16 (22 %) of them have certificate. Though only 4 (6 %) of the respondents are neither degree nor diploma nor certificate holders, they had some level of educational training.

In relation to the number of years that the respondents have been functioning as executives in their firms, 24 (33 %) of them have been performing managerial duties for more than 7 years. Twenty eight (39 %) of them have been executives for periods between 3 and 6 years. Thirteen (18 %) of them have been executives for a duration between 1 and 2 years, with only 7 respondents having been executives for a period less than one year as the time of the data collection. The implication of the

distribution is that, majority of the executives surveyed were duly qualified and experienced to provide the needed information requested in the questionnaire administered.

4.2 Descriptive Assessment of Executives' Perceptions of Self-efficacy

The means (M), standard deviations (SD) and summarized frequency (F) measures of the respondents' perceptions of how good or poor their executive 'self-efficacies (ESE) are manifested is shown in Table 1.

By considering the combination of their current ability, resources and opportunity, it emerged that 65 (90.3 %) of the executives handle the time demands of their job and are able to maintain control of their personal daily schedules. In the same vein, 61 (84.7 %) of them handle the paper work required of the managerial job. Additionally, by shaping the operational policies and procedures that are necessary to manage their firms, as well as prioritising among the competing demands of their jobs, these executives are able to cope with the stresses of their

Table 1 Summary of executives' assessment of self-efficacy

Self-efficacy indicators	M	SD	Good ESE		Poor ESE	
			F	% F	F	% F
Handling the time demands of the managerial job	3.22	0.89	62	86.11	10	13.99
Handling the paper work required of the managerial job	3.13	0.95	61	84.72	11	13.28
Maintaining control of personal daily schedule	3.13	0.89	63	87.50	9	12.50
Prioritizing competing demands of the managerial job	3.13	1.06	61	84.72	11	13.28
Coping with the stress aspect of the managerial job	3.07	0.97	61	84.72	11	13.28
Shaping firm's operational policies/procedures	3.00	1.06	61	84.72	11	13.28
Motivating employees to put in more effort at their job	3.28	1.05	62	86.11	10	13.99
Generating employee enthusiasm for shared firm vision	3.06	1.15	59	81.94	13	18.06
Managing change in the firm	3.00	1.06	59	81.94	13	18.06
Creating a positive working environment in the firm	3.22	1.08	62	86.11	10	13.99
Raising employees achievement on standardized tests	2.68	1.13	52	72.22	20	27.78
Facilitating employee on their job	2.99	1.07	58	80.56	14	19.44
Promoting acceptable behavior among employees	3.21	1.05	63	87.50	9	12.50
Promoting organization spirit among employees	3.18	1.10	60	83.33	12	16.67
Handling the employee discipline in the firm	3.07	1.13	58	80.56	14	19.44
Promoting a positive image of the firm	3.36	1.05	63	87.50	9	12.50
Promoting prevailing values of community in the firm	2.94	1.12	57	79.17	15	20.83
Promoting ethical behavior among fellow executives	3.24	1.18	63	87.50	9	12.50

jobs. Sixty-two (86.1 %) of the executives noted that they create a positive working environment in their firms by promoting acceptable behaviour among their employees. They motivate their employees to put in more effort at their job through job facilitation, as well as appraise their achievements on standardized tests. Sixty (83.3 %) of them also indicated that they generate enthusiasm for a shared vision by promoting organization spirit among a large majority of their employees, which event makes it possible for them to inculcate discipline among their workers, and thus manage change in their organizations. It also emerged that, 63 (87.5 %) of the executives use the combination of their current ability, resources and opportunity to promote positive images of their firms by promoting the prevailing values of their organizations' communities, as well as the ethical behaviour among fellow executives. The conceptual importance of these observations is the emergence of the executives' self-efficacies as reflective of those characteristics that signifies superior performance. As it is observed in the analysis, the executives' perceptions of their influence on work activities and the use of their self-efficacies have a strong influence on their managerial performances.

4.3 Factor Analysis of Executives' Self-efficacy

The Kaiser-Meyer-Olkin (KMO) and Bartlett's test statistics for the self-efficacy indicators is shown in Table 2.

As shown in Table 2, the estimated KMO value for self-efficacy is 0.917, indicating that the correlation pattern for the self-efficacy indicators are good, as recommended by Field (2005). Furthermore, the estimated chi-square (χ^2) value from the Bartlett's test is $\chi^2 = 0.0012851$ ($p = 0.000$), which is highly significant ($p < 0.001$). The results from both the KMO and Bartlett's tests indicate that it is appropriate to analyse all the self-efficacy indicators tested, using principal component analysis.

In the principal component analysis using the extraction method, the total variance explained, yielded a two component matrix (i.e. components 1 and 2), as underlined by initial eigenvalues that are greater than one. Using the rotation method, underlined by Varimax with Kaiser Normalization which converged in 8 iterations, the rotated two component matrix (i.e. C1 and C2), with estimated regression (R) values for the indicators, are shown in Table 3.

As shown in Table 3, an analysis of the executives' self-efficacy shows that 15 indicators have factor loadings greater than 0.7, yielding a two-component solution. The first component (i.e. C1) contains eleven indicators, which together reflect the

Table 2 KMO measure of sampling adequacy and Bartlett's test result for self-efficacy

KMO measure	Bartlett's test of sphericity		
	χ^2	df	Sig.
0.917	0.001285	153	0.000

Table 3 Rotated component matrix with regression estimates for self-efficacy indices

Indicators	*R*-values	
	C1	C2
Handling the time demands of the managerial job	0.402	**0.748**
Handling the paper work required of the managerial job	0.316	**0.806**
Maintaining control of personal daily schedule	0.335	**0.796**
Prioritizing among competing demands of the managerial job	0.589	0.453
Coping with the stress aspect of the managerial job	0.216	**0.758**
Shaping operational policies and procedures necessary to manage firm	0.607	0.521
Motivating employees to put in more effort at their job	**0.705**	0.503
Generating employee enthusiasm for a shared vision for the firm	**0.816**	0.252
Managing change in the firm	**0.761**	0.403
Creating a positive working environment in the firm	**0.841**	0.284
Raising employees achievement on standardized tests	**0.794**	0.303
Facilitating employee on their job	**0.843**	0.274
Promoting acceptable behavior among employees	**0.781**	0.343
Promoting organization spirit among a large majority of employees	**0.711**	0.406
Handling the employee discipline in the firm	0.654	0.486
Promoting a positive image of the firm	**0.729**	0.494
Promoting the prevailing values of the community in the firm	**0.790**	0.349
Promoting ethical behavior among fellow executives	**0.748**	0.315

executives' manifestation of human relation skills in their managerial decision-making. These indicators are; (i) motivating employees to put in more effort at their job. (ii) generating employee enthusiasm for a shared vision for the firm, (iii) managing change in the firm, (iv) creating a positive working environment in the firm, (v) raising employees achievement on standardized tests, (vi) facilitating employee on their job, (vii) promoting acceptable behaviour among employees, (viii) promoting organization spirit among a large majority of employees, (ix) promoting a positive image of the firm, (x) promoting the prevailing values of the community in the firm, and (xi) promoting ethical behaviour among fellow executives. In this respect therefore, this component (i.e. component 1) is labelled *charismatic influence*. The second component (i.e. C2) contains four indicators which together reflect the executives' organizing capabilities in their managerial activities. These indicators are; (i) handling the time demands of the managerial job, (ii) handling the paper work required of the managerial job, (iii) maintaining control of personal daily schedule, and (iv) coping with the stress aspect of the managerial job. In this respect therefore, this component (i.e. component 2) is labelled *organizing capability*.

Based on the above findings, Pearson correlation test was conducted to find out if there is influencing relationships between the self-efficacy indicators of the executives' *charismatic influences* and their *organizing capabilities*. The correlation estimates are shown in Table 4.

Table 4 Correlation estimates for relationships between executives' charismatic influence and organizing capability self-efficacy indicators

Charismatic influence self-efficacy indicators	Organizing capability self-efficacy indicators			
	Handling time demands of managerial job	Handling paper work required of managerial job	Maintaining control of personal daily schedule	Coping with stress aspect of managerial job
Motivating employees to put in more effort at their job	0.625	0.643	0.657	0.437
Generating employee enthusiasm for a shared vision for firm	0.579	0.485	0.504	0.351
Managing change in the firm	0.595	0.560	0.568	0.507
Creating a positive working environment in the firm	0.593	0.455	0.471	0.471
Raising employees' achievement on standardized tests	0.522	0.527	0.521	0.370
Facilitating employee on their job	0.565	0.502	0.567	0.409
Promoting acceptable behavior among employees	0.644	0.555	0.532	0.388
Promoting organization spirit among employees	0.574	0.543	0.580	0.475
Promoting a positive image of the firm	0.619	0.561	0.585	0.569
Promoting the prevailing values of the community in the firm	0.546	0.482	0.572	0.443
Promoting ethical behavior among fellow executives	0.511	0.564	0.509	0.367

The correlation estimates in Table 4 showed that all the self-efficacy indicators reflecting the executives' exhibition of charismatic influence in their employees correlated significantly with their self-efficacy indicators, reflecting their organizing capabilities of their firms' activities. In this respect, it could be postulated that the executives ability to handle the time demands and the paper work required of their managerial jobs, on the one hand, and their ability to maintain control of their personal daily schedule, and cope with the stress aspect of their managerial job, on

the other, had a direct positive impact on their abilities to; motivate their employees to put in more effort at their jobs, generate their employees' enthusiasm in their firms' visions, manage change in their firms, create positive working environments in their firms, raise their employees' achievements on standardized tests, facilitate their employees on their jobs, promote acceptable behaviours among their employees, promote organization spirit among a large majority of their employees, promote a positive image of their firms, promote values of the community that prevail in their firms, and promote ethical behaviours among their fellow executives.

5 Conclusion

This study has shown that the executives of small firms in Ghana exhibit self-efficacies which they manifest variously as charismatic influences and organizing capabilities. The executives showed high levels of organizing capabilities and charismatic influences on the work they manage as a result of their self-efficacies. It is found that the self-efficacy indicators reflecting the executives' exertion of charismatic influences on their employees correlated significantly with their self-efficacy indicators reflecting their capabilities to organize their firms' activities. It is therefore concluded that the executives' use of their charismatic influence-oriented and organizing capability-oriented self-efficacies has a positive influence on their abilities to manage their small firms. It is also concluded that, the executives ability to handle the time demands and the paper work required of their managerial jobs, on the one hand, and their ability to maintain control of their personal daily schedule, and cope with the stress aspect of their managerial job, on the other, had a direct positive impact on their abilities to carry out the following functions;

- Motivate employees to put in more effort at their jobs,
- Generate employees' enthusiasm in the firms' visions,
- Manage change in the firms,
- Create positive working environments in the firms,
- Raise employees' achievements on standardized tests,
- Facilitate employees on their jobs,
- Promote acceptable behaviours among employees,
- Promote organization spirit among employees,
- Promote a positive image of firms,
- Promote values of the community that prevail in the firms,
- Promote ethical behaviours among fellow executives.

The conclusions above are relevant for the reason that it has provided both practical and theoretical insights into aspects of the management skills exhibited by executives of small business in Ghana in the daily management of their firms. The

findings contribute to the sum total of knowledge in the study and practice of managerial self-efficacy in the field human resource management. Specifically, for Ghana, this research provides a platform for the development of a database that will help inform policy-makers on the requisite self-efficacies to be required of small firms' executives in the daily management of their businesses.

References

1. Amit, R., Schoemaker, P.J.H.: Strategic assets and organizational rent. Strateg. Manag. J. **14**, 33–46 (1993)
2. Bandura, A.: Social Foundations of Thought and Action: A Social Cognitive Theory. Prentice-Hall, Englewood Cliffs, N.J (1986)
3. Bandura, A.: Self-efficacy: The Exercise of Control. W.H. Freeman & Company, New York (1997)
4. Barney, J.B.: Organizational culture: can it be a source of sustained competitive advantage? Acad. Manag. Rev. **11**, 656–665 (1986)
5. Barney, J.B.: Firm resources and sustained competitive advantage. J. Manag. **17**, 99–120 (1991)
6. Barney, J.B.: Integrating organizational behaviour and strategy formulation research: a resource-based analysis. In: Shrivastava, P., Huff, A., Dutton, J. (eds.) Advances in Strategic Management, vol. 8, pp. 39–61. JAI Press, Greenwich, CT (1992)
7. Boyd, N.G., Vozikis, G.S.: The influence of self-efficacy on the development of entrepreneurial intentions and actions. Entrepreneursh. Theory Pract. **18**(4), 63–77 (1994)
8. Chen, C.C., Greene, P.G., Crick, A.: Does entrepreneurial self-efficacy distinguish entrepreneurs from managers? J. Bus. Ventur. **13**, 295–317 (1998)
9. Conner, K.R.: A historical comparison of resource-based theory and five schools of thought within industrial organization economics: do we have a new theory of the firm? J. Manag. **17**, 121–154 (1991)
10. Cox, L.W., Mueller, S.L., Moss, S.E.: The impact of entrepreneurship education on entrepreneurial self-efficacy. Int. J. Entrepreneursh. Educ. **1**(2), 229–247 (2002)
11. De Noble, A., Jung, D., Ehrlich, S.: Entrepreneurial self-efficacy: The development of a measure and its relationship to entrepreneurial action. In: Frontiers of Entrepreneurship Research. Babson College, Boston, MA (1999)
12. Earley, P.C.: Self or group? Cultural effects of training on self-efficacy and performance. Admin. Sci. Q. **39**, 89–109 (1994)
13. Gist, M.E., Mitchell, T.R.: Self-efficacy: a theoretical analysis of its determinants and malleability. Acad. Manag. Rev. **17**, 83–211 (1992)
14. Hansen, G.S., Wernerfelt, B.: Determinants of firm performance: the relative importance of economic and organizational factors. Strateg. Manag. J. **10**, 399–411 (1989)
15. Krueger, N.F., Brazeal, D.V.: Entrepreneurial potential and potential entrepreneurs. Entrepreneursh. Theory Pract. **18**(3), 91–104 (1994)
16. Lado, A.A., Boyd, N.G., Wright, P.: A competency-based model of sustainable competitive advantage: toward a conceptual integration. J. Manag. **18**, 77–91 (1992)
17. Mahoney, J.T., Pandian, J.R.: The resource-based view within the conversation of strategic management. Strateg. Manag. J. **13**, 363–380 (1992)
18. Mueller, S.L.: Gender-role orientation as a determinant of entrepreneurial self-efficacy. J. Dev. Entrepreneursh. **13**(1), 3–20 (2008)
19. Mueller, S.L., Goic, S.: East-West differences in entrepreneurial self-efficacy: Implications for entrepreneurship education in transition economies. Int. J. Entrepreneursh. Educ. **1**(4), 613–632 (2003)

20. Reed, R., DeFillippi, R.: Causal ambiguity, barriers to imitation, and sustainable competitive advantage. Acad. Manag. Rev. **15**, 88–102 (1990)
21. Rumelt, R.P.: How much does industry matter? Strateg. Manag. J. **12**, 167–185 (1991)
22. Sanda, M.A., Sackey, J., Fältholm, Y.: Managerial competence and non-performance of small firms in a developing economy. Int. J. Contemp. Bus. Stud. **2**(3), 6–24 (2011)
23. Scherer, J.L., Adams, J.S., Carley, S.S., Wiebe, F.A.: Role model performance effects on development of entrepreneurial career preference. Entrepreneursh. Theory Pract. **13**(3), 53–71 (1989)
24. Sequeira, J.M., McGee, J.E., Mueller, S.E.: An empirical study of the effect of network ties and self-efficacy on entrepreneurial intentions and nascent behaviour. In: Proceedings of the Southern Management Association 2005 Meeting. Charleston, South Carolina (2005)
25. Stajkovic, A.D., Luthans, F.: Self-efficacy and work related performance: a meta—analysis. Psychol. Bull. **124**(2), 240–261 (1998)
26. Stevens, C.K., Gist, M.E.: Effects of self-efficacy and goal oriented training on negotiation skill maintenance: what are the mechanisms? Pers. Psychol. **50**, 955–979 (1997)
27. Ulrich, D., Lake, D.: Organizational Capability. Wiley, New York (1990)
28. Urban, B.: Entrepreneurial Self-efficacy in a multicultural society: measures and ethnic differences. SA J. Indus. Psychol. **32**(1), 2–10 (2006)
29. Wernerfelt, B.: A resource-based view of the firm. Strateg. Manag. J. **5**, 171–180 (1984)
30. Wood, R., Bandura, A.: Social cognitive theory of organizational management. Acad. Manag. Rev. **14**, 361–381 (1989)
31. Wright, P.M., McMahan, G.C.: Theoretical perspectives for strategic human resource management. J. Manag. **18**, 295–320 (1992)
32. Zhao, H., Seibert, C.: The moderating role of self-efficacy in the development of entrepreneurial intentions. J. Appl. Psychol. **90**(6), 1265–1272 (2005)

Applying Decision Analysis to Human Factors in Decision Making at Stanford University Medical Center

John Celona

Abstract Decision-making is a fundamental life skill, yet people reliably and predictably make decisions which, upon a more careful consideration, they no longer agree with. Developed over the last 50 years, decision analysis drew from statistical decision theory, cognitive psychology, economics, and system engineering to comprise a philosophy, theory, and methodology for making better decisions in complex and uncertain situations. We briefly discuss decision analysis, then show how it was applied to making better decisions in medical malpractice cases at Stanford University Medical Center.

Keywords Decision analysis · Human factors · Medical malpractice · Insurance reserve decisions

1 Introduction

As mankind greatly altered its living environment over the last few 1000 years, some human traits well honed by evolution in the preceding millennia appear now to be maladaptive—and evolution has not yet had time to catch up.

For example, metabolisms and calorie storage capacities which worked well when brief spurts of plenty were inevitably followed privation result in excess fat accumulation in the modern situation of perpetual plenty. Health suffers as a result.

Other potentially helpful traits have yet to develop. The ability to know which way is up when the horizon is not visible is basic to birds but absent in humans, who never had an issue knowing which way the ground was. This deficit challenges pilots who must consciously ignore intuition and rely on instruments to avoid crashing.

J. Celona (✉)
Decision Analysis Associates, LLC, San Carlos, CA, USA
e-mail: JCelona@DecisionAA.com

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So it is with decision-making. Our thought processes and decision-making heuristics are well-tuned for avoiding being eaten by predators and evaluating possibly hostile intentions when encountering another human.

However, as humanity has developed its environment and economy for greater comfort, safety, convenience and wealth, it has created complex social, economic, and technological systems which defy purely intuitive evaluation.

This development has also created new and greater sources of uncertainty for which we have not yet developed reliable intuition. Greater development magnifies the impacts of natural sources of uncertainty (storms, floods, earthquakes, etc.). Economies and financial markets turn rapidly and unpredictably on the collective sentiments of large numbers of people about whom we have some or no information, and no direct contact to evaluate their judgments or intentions.

Decision analysis was developed to address these human factors in decision-making through providing a philosophy, theory, and methods of making better decisions in even the most complex and uncertain situations. Decision analysis provides a path to clearly understanding which alternative is best and why which stands up to careful scrutiny and maximizes your odds of enjoying a favorable outcome.

2 How Decision Analysis Works

Thankfully, evolution has equipped us with two very powerful and complimentary thinking and decision-making modes which can interact to develop and reprogram how we make decisions and to make better decisions. Decision analysis structures the action and interaction of both these modes.

This first mode is the fast, intuitive mode which I call the "Intuitive Supercomputer" and which Daniel Kahneman refers to as "Type 1" thinking [1]. This is the way we make most decisions: we just sort of think about it a bit (or not!) and then decide.

The Intuitive Supercomputer is fast, easy, intuitive, and works well most of the time. It employs subtle and complex reasoning processes which are difficult to trace or describe. It is highly specialized for understanding other people and governs emotions, trust, empathy and—most importantly—action! People are never convinced or act unless their intuition is on board.

However, this mode of thinking and decision making reliably and predictably goes astray with even a little uncertainty or complexity [1]. Hence the need to supplement it.

Fortunately, we are also equipped with another mode which I call the "Logical Co-processor" and which Kahneman refers to as "Type 2" thinking. It is slower and more effort to invoke, but less prone to error. It requires concentration and focus—at the risk of possibly solving the wrong problem. It uses transparent, logical reasoning, but does not lead to action unless trusted and persuasive. Hence the need to convince the Intuitive Supercomputer.

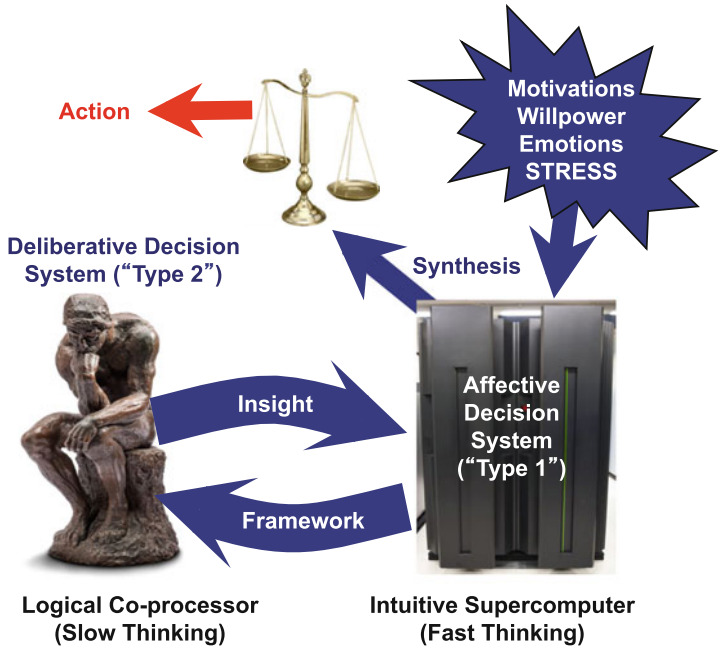


Fig. 1 Decision analysis frames the interchange between your Intuitive Supercomputer and logical co-processor to create a clear and persuasive rationale for which course of action is best and why

Decision analysis works by using intuition to construct the frame for the decision: the alternatives, preferences, and information. A great alternative is like a great idea: there is no set process for coming up with one; you just do. Intuition works great for this. There are also brainstorming techniques which can help.

The logical co-processor can then consider this frame more carefully. What could happen? What is that worth? What are the chances of that or something else? In decision analysis we construct a quantitative model for analysis, including evaluating alternative scenarios. We refer the reader elsewhere for details of how to undertake and evaluate formal analysis [2–4].

The results of the analysis generate insights which feed back to the Intuitive Supercomputer for synthesis: do the results make sense? Are we missing something? Do we have a cogent and clear understanding of which alternative is best and why which can be briefly, persuasively communicated?

This powerful, structured interaction of our two innate thinking modes is the strength of decision analysis. These relationships are shown in Fig. 1.

When Einstein created his Theory of Relativity, he was asked "Where is your lab work?" He didn't get there via physical experimentation. Instead, he conducted his famous "thought experiments" (the trains moving past each other, etc.) to create the theory [5].

In the same way, decision analysis allows you to create thought experiments as to which course of action could be best and why *before* acting. This kind of forethought is absolutely critical for most important decisions on life in which you get only one chance to act and cannot "rewind the tape" to try a different plan.

3 The Elements of Decision Analysis

One of the elements of a decision analysis (and decisions in general) is the alternatives: what are the different possible things you could do? One of the key distinguishing features of decision analysis is we always examine multiple alternatives, including the "do nothing" alternative against which we can compare the possible risks and benefits of doing something. This is in stark contrast to the more common advocacy mode of decision making in which there one proposed course of action. The complete set of elements is shown in Fig. 2.

A second element is information, which includes all the data one can muster, plus quantification of the possible things that could happen. In cases where there is (1) a good historical data set; and (2) a stable system, statistical analysis of historical data can furnish decent prospects for future uncertainty. One example is pricing life insurance. There is a lot of data and people aren't suddenly living longer or dying sooner, so analysis of historical data is a good guide.

However, these two conditions are often lacking and this shortfall is typically ignored: analyzing data is the hammer people know how to pound quite well. The results can be catastrophic, as in the use of historical data to price mortgage-based securities leading to the 2008 financial crisis (as related to the author by people at the ratings agencies). Hence the need to supplement data analysis with subjective, Bayesian probabilities.

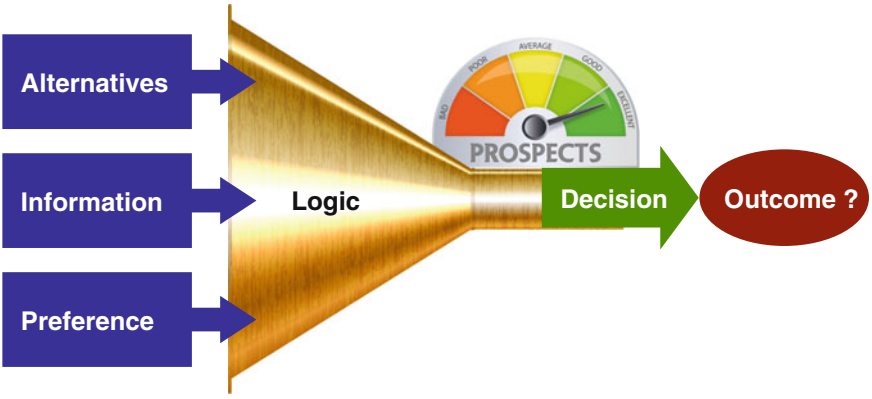


Fig. 2 The elements of a good decision

Bayesian probabilities date back over three centuries to the Reverend Thomas Bayes and most people are unfamiliar with them though they see them every day. Check your weather forecast: the chance of rain a week from tomorrow is a Bayesian probability expressed as a percentage (e.g., 40 %). Check it in 2 days and the number will likely be different—though the available historical data has not changed a bit. Bayesian probabilities are a person or persons' view as to the likelihood of a particular event based on what they know at the time. When the information or your evaluation of it changes, we would expect the probability to likewise change.

Use of Bayesian probability is one of the key distinguishing features of decision analysis and why it works better. It is also one of the most controversial, but it is a battle well worth fighting. The fact that it works so well is the reason decision analysis has become standard in risky, high-stakes industries like drug development and upstream oil and gas. Before a drug is developed at Pfizer, Merck or Genentech or a project is undertaken at Exxon or Chevron, there is a decision analysis of its prospects [6].

A third element is preferences, of which there are two parts. A time value of money is used to convert funds flows occurring over time to net present values for ready comparisons to other flow patterns. Second, a risk preference is used to translate uncertain prospects to what the equivalent certain amount would be for the decision maker(s).

This use of a quantified attitude towards risk as another distinguishing feature of decision analysis. It contrasts with the "risk tolerance" approach commonly applied where it is simply specified "we won't tolerate X"—with no inquiry as to what the costs of preventing X or allowing a little X would be.

These elements are put into a quantitative model (the "thought experiment") to analyze the potential outcomes. The results typically include values for individual scenarios and a probability distribution on total value to show the complete set of prospects for a particular alternative. Distributions are often summarized with a mean value.

These results drive the ultimate decision, following which is an outcome: what actually happens once the decision has been made and acted upon.

Decision analysis also furnishes a definition of a good decision: one that is logically consistent with everything known *at the time the decision is made*. We distinguish a good outcome as what you hope will happen.

This approach is in stark contrast to how people typically evaluate decisions: it was a good decision if things turned out well, and a bad decision if they don't. Promotions and compensation plans as well as political fortunes typically work this way. In many cases, they reward luck rather than a well-considered decision.

Decision analysts take this different perspective and, in fact, document the basis for the decision at the time it is made for later review in light of how things turn out. This saves jobs and careers as well as improving the quality of future decisions.

4 Applying Decision Analysis at Stanford University Medical Center

Stanford Hospital self-insures medical malpractice liability through a Bermuda-based captive insurance company, the Stanford University Medical Indemnity Trust (SUMIT). Accordingly, for each case SUMIT must manage the decisions facing client, counsel, and the insurance company, namely:

- Whether to settle or continue litigating;
- How much to offer or pay in settlement negotiations;
- Where to direct legal and factual investigations;
- How much to reserve for potential damages (indemnity);
- How much to reserve for costs (legal fees and experts).

Amounts required to fund SUMIT are charged as insurance premiums to Stanford Hospital.

Our involvement had a number of objectives:

- Insure that amounts reserved were enough to cover potential exposure (avoiding unpleasant surprises and the need to put in more money) without being over-reserved (which means Stanford Hospital was charged more than necessary for insurance premiums).
- Ensure that total reserves met regulatory and prudential standards for captive insurance companies.
- Set early and stable reserves to eliminate "stair step" increases in reserves.
- Minimize the total cost of cases by resolving them for less than exposure at trial.

Applying decision analysis furnished the means of achieving the objectives. The question was how to apply it routinely and economically for each and every case. To do so, we thought like a decision analyst and considered a number of alternatives.

The first alternative was continuing the status quo of making educated guesses based on experience. However, typical prior practice was starting reserves at a token amount and continually increasing them as a case progressed. This situation was flagged as a problem because reserves at any one time were neither a good picture of the outstanding exposure nor sufficient provision to cover it. In addition, there were a number of bad surprises when cases required far more to resolve than what was reserved.

The second alternative was to develop and fill out templates for each case, as is commonly done for drug and oil development projects. The concern here was that the templates would freeze the level of analysis at a fairly basic level not adequate for the variation in the cases and which didn't provide needed guidance for case management.

The third possibility was developing an expert system ("analyst in a box") for case analysis, as I have worked on for portfolios of R&D projects. However, the cost and time required to develop such a system are considerable.

The last alternative was to develop the "wetware": the expertise of staff assisted by an expert analyst (myself) to quickly conduct custom analysis for each case. The issue here was the steep learning curve for staff attorneys, doctors, and claims managers with no prior experience in decision analysis.

The first alternative was unattractive because it merely continued the issues leading to this effort. The second and third required a considerable up-front investment along with their other issues. We decided to try the last alternative both to get started right away and because, if it proved unsatisfactory, the work completed would provide a necessary basis for switching to the second or third alternatives.

5 Getting Started

We began with creating a business process to implement the last alternative of conducting a rapid, custom analysis of each case. This process is called the Decision Analysis Reserve and Trial Strategy (DARTS) process. Following an initial 2-day training session, it involved:

- Convening regular meetings to discuss, analyze, and update cases.
- Developing and analyzing a custom model for each case in real time (2–3 h for most cases).
- Immediately feeding back the results: Do they make sense? Are we missing something? What if…?
- Continually developing staff understanding and expertise.

For each required decision, we specified the decision analysis result which would guide it, as described in Table 1.

Initial efforts were focused on introducing staff to thinking in terms of possibilities, probabilities, and alternative scenarios. Figure 3 shows the decision tree from one of the very early analyses.

Note that the Special Damages appearing after General Damages not connected implies node replication: no matter how General Damages turns out, there is still an uncertainty on Special Damages with possible outcomes ranging from $5–15 K.

Table 1 Required decisions and guidance from decision analysis results from DARTS

Decision	DARTS output guidance
Indemnity reserve	Mean value of exposure at trial
Cost reserve	Mean value of total cost exposure
Settle or litigate	Go to trial if no settlement for less than trial exposure
Settlement offer	Less than mean value of trial exposure
Legal and factual investigations	Key issues identified in discussion and sensitivity analysis of trial exposure

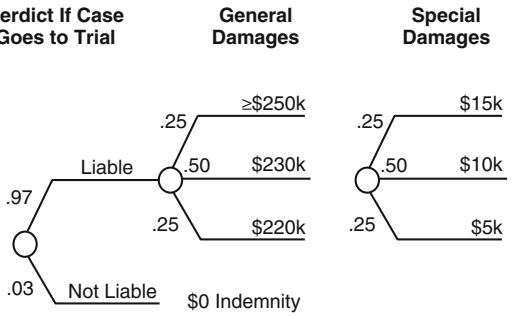


Fig. 3 Decision tree from an early DARTS case analysis

This early tree illustrates the usual difficulties in beginning to think about ranges of uncertainty. The ranges on both General Damages and Special Damages are very likely much more narrow than what the actual uncertainty was in this case. Thankfully, assessing Bayesian probabilities and thinking in terms of alternate possibilities is a learned skill and people get better over time with practice. Figure 4 shows a tree from a more recent case and the vast difference in how staff's thinking about cases changed over time.

Here we see a much more sophisticated approach to modeling the issues and uncertainties in a case. In particular, there are many conditional probability assessments, such whether Dr. X's testimony for the defendant is interpreted by the jury as an admission of fault affecting the "Balance of the Experts": which expert witness are persuasive to the jury. The conditional assessments in this tree are so

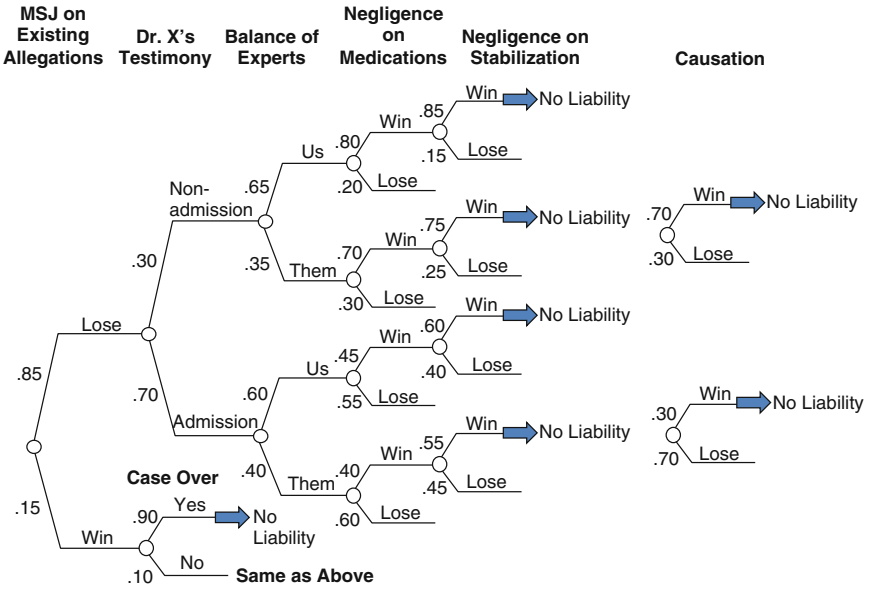


Fig. 4 Decision tree from a recent DARTS case

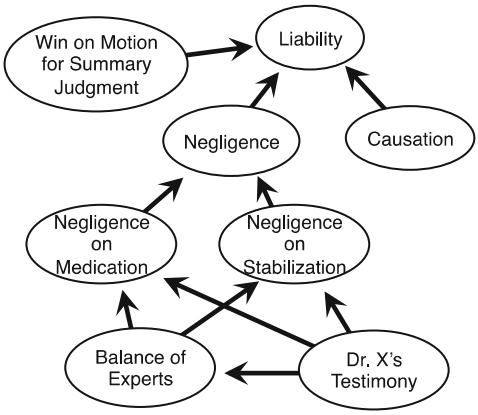


Fig. 5 Relationships from decision tree shown in relevance diagram form

complex it is perhaps easier to view those dependencies in the form of a relevance diagram (Fig. 5).

In my experience, dependencies between decisions and uncertainties are often present, usually critical when they are, and often missed when using standard analysis templates. Capturing the dependencies in a particular case is one of the great strengths of doing a custom but "as simple as possible but no more" analysis.

This greater sophistication in thinking about possibilities and probabilities in uncertain and complex cases is not only reflected in better analysis results, but also in staff's perception of the value of applying decision analysis. They uniformly agree that much of the value comes from the improved understanding of the case that the process yields. This better informs them in managing the case and in dealing with opposing parties.

There is no magic in the decision analysis process. It just supplies a structured and theoretically sound process for making better use of your innate cognitive abilities (intuitive and logical) to reach a better understanding of what is best to do and why.

6 Results

For a single case or decision, it can be difficult to evaluate how good the decision analysis process was. Quantifying and analyzing the uncertainty does not make it go away, and a good decision can still result in an unfortunate outcome.

However, over multiple decisions (claims in this case), it is possible to compare predicted against actual results and see how well your decision analysis process is guiding your decisions. Pharmaceutical and oil and gas companies do this routinely, and we were able to do this for Stanford.

Over the first 2 years, we analyzed fifty cases. Twenty-five have been resolved and the rest were still pending as of when we looked at the results. Seven cases were

Table 2 Results and predicted probability of liability at trial for cases resolved with no indemnity payment

How case was resolved	Predicted probability of liability at trial (%)	Indemnity reserve
Defense verdict at trial	25	$106 K
Case dismissed	5	$40 K
Summary judgment for defense	5	$76 K
Statute of limitations expired Before case filed	34	$873 K
Case dismissed	24	$75 K
Case dismissed	20	$59 K
Summary judgment for defense	5	$83 K

resolved with no indemnity payment at all. The first question, then, was how those case were resolved and if we correctly predicted a low probability of liability if the case went to trial. The results are shown in Table 2.

Note that only the first case actually went to trial, and that the amounts reserved for indemnity accounted for the predicted probability of liability if a case went to trial. The mean indemnity given a finding of liability at trial is the indemnity reserve divided by the probability of liability (e.g., 106 ÷ 0.25 = $424,000 for the first case).

Our working conclusion (always pending more data) is that the decision analysis was able to correctly predict low prospects for liability if a case went to trial in cases resolved with no indemnity payment.

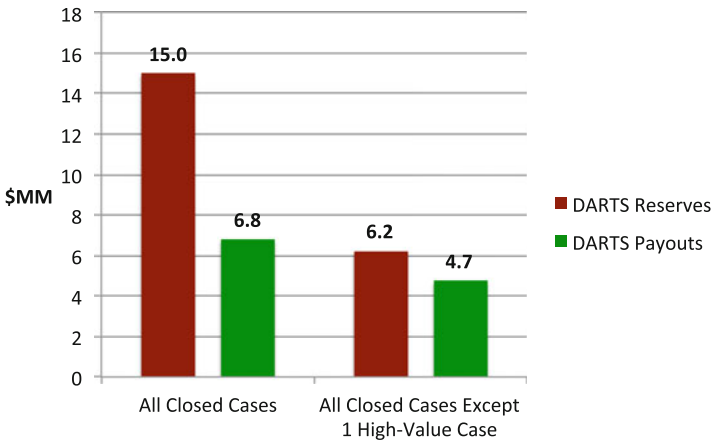


Fig. 6 Amounts reserved versus actual payouts for all closed cases

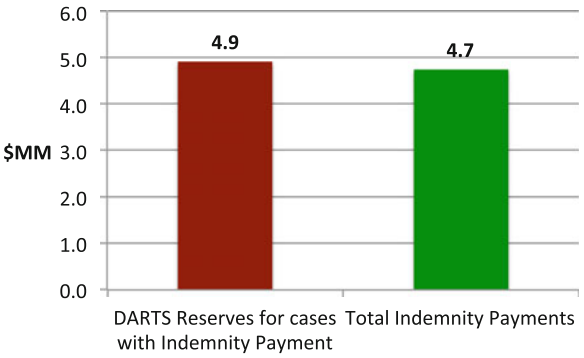


Fig. 7 Payouts versus reserves for cases with an indemnity payment excluding one high-value case

Next we looked at total payouts versus reserve amounts for all closed cases (Fig. 6).

These results include the cases resolved for no indemnity payment. In total, we were successful in resolving cases for less than the predicted exposure at trial. The next view was looking only at cases for which there was an indemnity payment except the one high-value case in which an exceptionally favorable settlement was reached (Fig. 7).

This chart shows close matching between predicted exposure at trial and amounts paid to resolve cases, and success in resolving case for less than exposure at trial. We next looked at variance between the amounts to resolve cases and the mean exposures from the decision analysis to see if there were systematic biases in the estimates (Fig. 8).

The distribution looks roughly uniform, indicating no systematic biases in over- or under-estimating the exposure. We would expect variation from the calculated mean because analyzing the uncertainty does not make it go away.

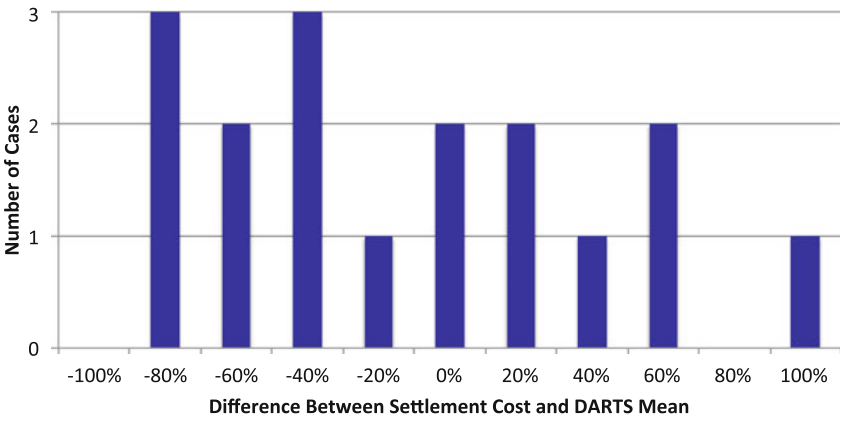


Fig. 8 Differences between amounts to resolve cases and analyzed mean exposures at trial as a percentage of the mean exposure at trial

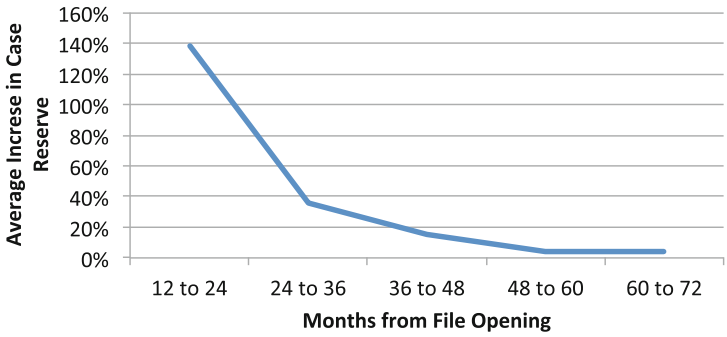
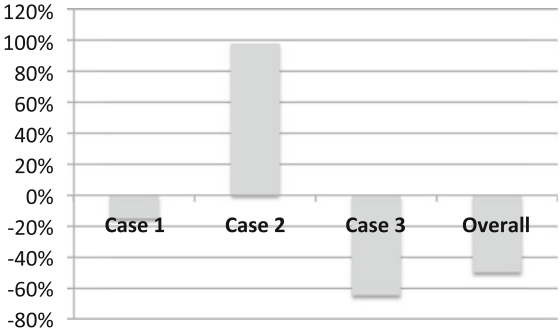


Fig. 9 Prior average change in case reserves over time

Fig. 10 Changes in case reserves with revised decision analyses



The last question was how well we did in making an early and stable evaluation of case exposure to avoid the prior "stair step" increases in case reserves. The changes in amounts reserved are known as "loss development." Following is Stanford's prior and typical loss development from actuarial methods (analysis of historical data) (Fig. 9).

Our experience with cases we analyzed was quite different. For almost all the cases, there was no change at all in case reserves—despite repeated reviews as a case developed and new information came in. In only three cases was the reserve changed.

Overall, the change in total reserves was a decrease. In actuarial terms, this would be known as negative loss development and is entirely contrary to usual experience (Fig. 10).

7 Conclusions

We were successful in achieving our objectives of resolving cases for less than the potential exposure at trial, and in achieving early and stable evaluation of case exposure. This was despite the great uncertainty, complexity, variation, and paucity of information for many of the cases. Staff learned that even when "there was no information," they actually had quite a lot of information for evaluating case prospects.

In addition, we were successful at identifying which issues and uncertainties were critical in determining exposure, and in directing subsequent legal and factual inquiries into those issues. This resulted in considering savings in legal fees, discovery, and expert witness costs.

Lastly, we would note that, although this work was for cases in which Stanford was a defendant, the methods work equally well for plaintiffs and for insurance companies on both sides of a case.

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References

1. Kahneman, D.: Thinking, Fast and Slow. Farrar, Straus and Giroux, New York (2011)
2. McNamee, P., Celona, J.: Decision Analysis for the Professional, 4th edn. SmartOrg., Inc., Menlo Park, California (2007)
3. Howard, R.A., Abbas, A.E.: Foundations of Decision Analysis. Pearson, New York (2016)
4. Celona, J.: Winning at Litigation through Decision Analysis. Springer, New York (2016)
5. Einstein, E.: Relativity. Crown Publishers, Inc., New York (1961)
6. https://www.youtube.com/watch?v=JRCxZA6ay3M

Exploring Potential of Blue-collar Workers in the Information Manufacturing System

Na Yu, Chang Zhang, Liming Shen and Siegfried Lewark

Abstract A case study gave an evaluation of work satisfaction of employees working with the information manufacturing system in Chinese furniture manufacturing firms. Indicators of general satisfaction, security satisfaction, social satisfaction, supervisory satisfaction and growth satisfaction were assessed by using questionnaire survey. Results of the study revealed that 5 indicators are significantly correlated. Comparing the differences among employees doing different jobs, supervisory satisfaction and growth satisfaction of blue-collar workers are both significantly lower than groups of managers and white-collar workers. The authors suggest that human factors is a key in the information manufacturing system, especially with the group of blue-collar workers. Dealing relationship between workers and their supervisors, and completing training system are helpful for the sustainable development of the furniture manufacturing firms.

Keywords Human factors · Workers · Information manufacturing system · Work satisfaction

1 Introduction

Human factors is significant component in manufacturing management, which require strategic and operational management and best practices to be recreated to consider the dynamics and interrelationships between people, machines and job tasks [1]. In an information manufacturing system, operators are center of the system, even the advanced technology is seemed as a key. Job satisfaction may

N. Yu (✉) · C. Zhang · L. Shen · S. Lewark
Faculty of Furniture and Industrial Design, Nanjing Forestry University,
Longpan Road 159#, Nanjing, Jiangsu, China
e-mail: yuna96@hotmail.com

S. Lewark
Faculty of Forest and Natural Resource, University of Freiburg,
Werthmannstr.6, 79085 Freiburg, Germany

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affect employees' willingness to respond positively to enrich their work [2]. Aiming at their effective work, organizations have to put a great deal of effort to the task of motivating employees to accept organizational goals [3]. For exploring the potential of the information manufacturing system in the Chinese furniture firms, the study was carried out to study the work satisfaction of workers in case study firms.

2 Methodology

A round of questionnaire survey and face-to-face interviews were carried out in case study firms.

2.1 Data Collection

The questionnaire was designed with questions from the Job Diagnostic Survey (JDS), which was described by Hackman and Oldham [4, 5]. Five indicators about work satisfaction of workers were ananlyzed by the survey, inclucing general satisfaction, security satisfaction, social satisfaction, supervisory satisfaction and growth satisfaction. Descriptions of the indicatiors were presented in Table 1.

The questionnaire survey was filled by workers in 4 Chinese furniture manufacturing firms, which is using information manufacturing systems. Meanwhile, face-to-face interviews were assistant to understand the work situation of the workers on their jobs.

Table 1 Indicators described by Hackman and Oldham

Indicators	Description
General satisfaction	An overall measure of the degree to which the employee is satisfied and happy with the job
Security satisfaction	The degree of satisfaction with the amount of general security experienced as well as with the prospects of security
Social satisfaction	The degree of satisfaction with other workers with whom contact is made in the work situation, as well as satisfaction with opportunities to get to know and to help people
Supervisory satisfaction	The degree of satisfaction with the treatment, support and guidance received from supervisors, as well as the degree to which the general quality of supervision is considered satisfactory
Growth satisfaction	The degree to which an individual is satisfied with opportunities for growth in the job

2.2 Data Analysis

Data collected in the questionnaire survey was analyzed by using statistical methods and was computerized with the Statistical Package for Social Science (SPSS). Means and standard deviations of the indicators were calculated resulting in descriptive statistics. Correlations among the indicators were compiled by the method of Spearman. Moreover, one-way ANOVA was employed for analysis of variance between workers doing different jobs, such as managers, blue-collar workers and white-collar workers.

3 Results

3.1 Description of Samples

In total, 227 valid questionnaires were collected in the study. Participators include 35 managers, 130 blue-collar workers and 62 white-collar workers. All of them are working with information manufacturing systems in their firms. Around 50 % of the employees are young people with age less than 30 years old. Employees with age between 30 and 40 take 28 % and age more than 40 years old is about 15 % of the participators. Considering the manufacturing characteristics of the firms, most of the employees are male with percent of 84. Around 47 % of the participators only have highest study experience in primary school and junior middle school. Only around 25 % of them have higher education experience, and others were educated in high school or vocational school before they started their working in the firms.

3.2 Work Satisfaction of the Employees

Correlations among the 5 indicators of work satisfaction, including general satisfaction, security satisfaction, social satisfaction, supervisory satisfaction and growth satisfaction are presented in Table 2. The results presented shows that all of the indicators have significant corrections between each other ($p < 0.01$). Especially, growth satisfaction is higher correlated with supervisory satisfaction and social satisfaction.

3.3 Differences Between Employees Doing Different Jobs

The result of comparing the differences in work satisfaction among employess doing different jobs reveals that managers' work satisfaction is higher than

Table 2 Correlations of the indicators in the study

	A	B	C	D	E
A	1.00				
B	0.43**	1.00			
C	0.36**	0.35**	1.00		
D	0.42**	0.46**	0.45**	1.00	
E	0.45**	0.43**	0.49**	0.50**	1.00

Note *A*—general satisfaction, *B*—security satisfaction, *C*—social satisfaction, *D*—supervisory satisfaction, *E*—growth satisfaction
**Correlation is significant at the 0.01 level (2-tailed)

non-managerial employees. Futher more, there are significant differences in supervisory satisfaction and growth satisfaction between managers, blue-collar workers and white-collar workers ($p < 0.01$).

Figure 1 shows that supervisory satisfaction of managers (Mean = 5.27, SD = 0.94) is higher than white-collar workers (Mean = 4.80, SD = 1.01), both of them are higher than blue-collar workers (Mean = 4.52, SD = 1.28).

Figure 2 shows that growth satisfaction of managers (Mean = 5.02, SD = 0.76) is higher than white-collar workers (Mean = 4.42, SD = 0.09), both of them are higher than blue-collar workers (Mean = 4.41, SD = 1.00).

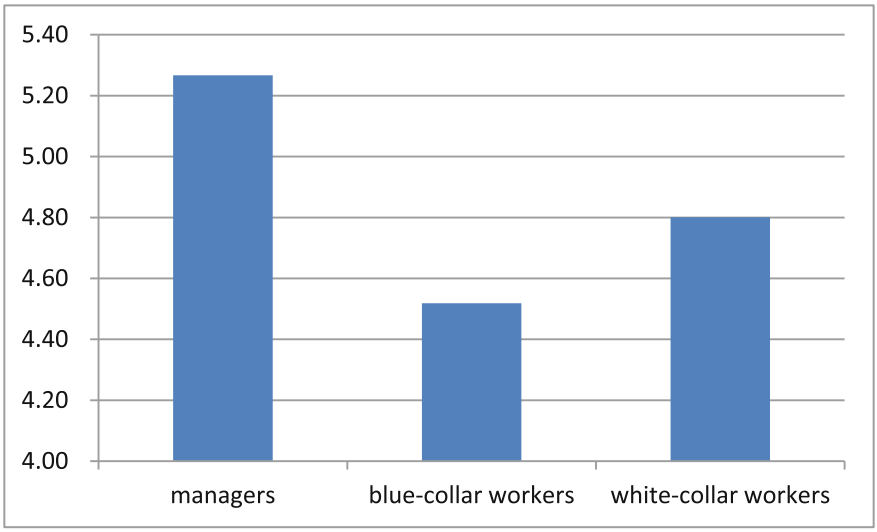


Fig. 1 Supervisory satisfaction of employees doing different jobs

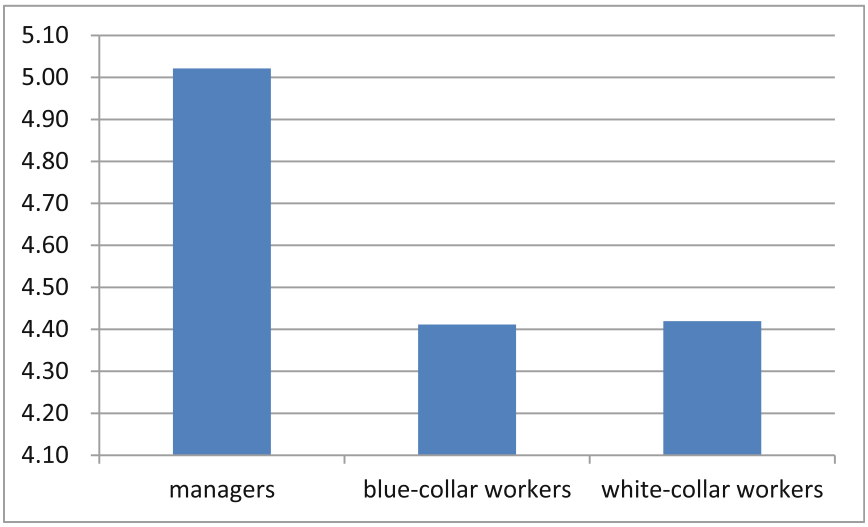


Fig. 2 Growth satisfaction of employees doing different jobs

4 Discussion

In recent years, numerous innovative activities have been carried out by pioneers in the Chinese manufacturing sectors in an attempt to enhance their competitiveness. The same situation exists in China's furniture industry [6]. Today, China has emerged as the largest furniture producer in the world, with 60,000 firms and over 6.5 million employees [7]. The implementation of information manufacturing system in China's furniture industry has conducted in the recent 10 years. The concept of information manufacturing system is considered as a fundamental management and manufacturing strategy of totally integrating all operational and information processing functions in manufacturing from order to product shipment in an enterprise, through design, engineering, planning, control, fabrication, and assembly, etc. [8–13]. Thus, the introduction of information manufacturing system has been considered a significant solution to solve lots of problems on production process, such as the need to reduce dependence on employees' work skills, difficulties in recruitment arising from increased labor costs and a shortage of skilled workers. However, most of activities were done in hardware aspect, such as using computer numberial control machinary (CNC), installing advanced manufacturing softwares and so on. But less of attentions were paid from human side. As a center in a manufacturing system, human factors is most important issues for success of the information manufacturing system adoption in China's furniture firms [14]. Skill training, appropriate welfare and flexible management should be offered to people working with the information system. Especially considering characteristics of the employees, who are quite young and less educated, comprehensive training

system helps to train them more clearly to know what they are doing and how could be better. However, the results of the study show us that works' supervisory satisfaction and growth satisfaction is significantly lower than managers' level, which may lead to low efficiency of the information system, considering the model of human, technology and organization (MTO).

5 Conclusion

Human factors is a key for a manufacturing system. The information manufacturing system is definied as a effective system integrating all of operation and production process with information technologies. The implementation of the new system offers a benefit for manufacturing firms changing from labor intensive manufacturing to automated manufacturing system. Meanwhile, task of employees will change in the technological innovation process. Workers should learn new knowledges and work skill for adopting to the changes in their jobs, though they are still used to work with their work experiences. Today, the way of learning from supervisors still widely existed, though there is highly technological development in China's furniture industry. Therefore, the relationship between workers and their supervisors is highly related to their growth satisfaction, which are both correlated to their job satisfaction and work motivation. We thus suggest that managers should pay more attention to deal with relationship between employees and their supervisors in the information manufacturing firms. In addition, training systems are suggested to complete for matching the technological changes in the Chinese furniture firms.

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References

1. Erlicher, L., Massone, L.: Human factors in manufacturing: new patterns of cooperation for company governance and the management of change. Hum. Factors Ergon. Manuf. Serv. Indus. **15**(4), 403–419 (2005)
2. Scott, M., Swortze, K.A., Taylor, W.N.: Extension agents' perceptions of fundamental job characteristics and their level of job satisfaction. J. South. Agric. Educ. Res. **55**, 1, 8–101 (2005)
3. Kleinbeck, U., Quast, H.H., Thierry, H., Haecker, H.: Work Motivation. Lawrence Erlbaum Associates, Inc., Hillsdale, New Jersey (1990)

4. Hackman, J.R., Oldham, G.R.: The Job Diagnostic Survey: An Instrument for the Diagnosis of Job and the Evaluation of Job Redesign Projects (Tech. Rep. No. 4). New Department of Administration Sciences, Yale University, New Haven, Conn (1974)
5. Hackman, J.R., Oldham, G.R.: Development of the job diagnostic survey. J. Appl. Psychol. **60** (2), 159–170 (1975)
6. Yu, N.: Process Innovation in China's Furniture Industry: Exploring the Potential of the Personnel for Successful Implementation of Advanced Manufacturing Technology. Shaker Verlarg, Aechen, Germany (2011)
7. Furniture Industry Development, Beijing, China http://www.chinaidr.com/news/2010-01/4178.html (2010)
8. Lei, D., Goldhar, D.: Computer-integrated manufacturing (CIM): redefining the manufacturing firm into a global service business. Int. J. Oper. Prod. Manag. **11**(10), 5–18 (1991)
9. Ramamurthy, K., King, W.R.: Computer integrated manufacturing: an exploratory study of key organizational barriers. Int. J. Manag. Sci. **20**(4), 475–491 (1992)
10. Sun, H., Tian, Y., Cui, H.: Evaluating advanced manufacturing technology in Chinese state-owned enterprises: a survey and case studies. Int. J. Adv. Manuf. Technol. **18**(7), 528–536 (2001)
11. Gunasekaran, A., Marri, H.B., McGaughey, R., Grieve, R.J.: Implications of organization and human behaviour on the implementation of CIM in SMEs: an empirical analysis. Int. J. Comput. Integr. Manuf. **14**(2), 175–185 (2001)
12. Nagalingame, S.V., Lin, G.C.I.: CIM still the solution for manufacturing industry. Rob. Comput. Integr. Manuf. **24**(3), 332–344 (2008)
13. Strohm, O., Eberhard, U.: Integral analysis and evaluation of enterprises: a multilevel approach in terms of people, technology, and organization. Hum. Factors Ergon. Manuf. **8**(3), 233–250 (1998)
14. Yu, N.: Drivers and barriers for implementing advanced manufacturing technology in China's furniture industry: an exploratory study. Forest Prod. J. **61**(1), 83–91 (2011)

Part VIII
Leadership Style

Global Challenges for the Universities and Managers Of the Higher Education Sector

Marcin Geryk

Abstract Global system of higher education is subject to constant change. The growing internationalization of the university changes the strategy of universities. The business model of the university is subject to a number of trials. Among other challenges is the growing dependence of the university on its surroundings. At the same time social changes and technological support cause the growth of awareness of the needs of universities stakeholders. The ease of travel and the possibilities for studying in another country cause a real challenge for the strategy of universities. These factors represent a challenge not only for university management, but also for societies that increasingly more explicitly articulate their expectations in relation to the university. Meeting these expectations in an unstable economic and political environment turns out to be, perhaps, the most important challenge for the managers of universities over the next two to three decades.

Keywords Higher education institutions · Demographic changes · University management · Stakeholders · Students

1 Introduction

Higher education institutions play a very important role in modern societies. Globalizing processes strengthen the mobility of students. That means a challenge for schools but also huge threats of coping with ethnic diversity. The quickly growing number of students in Asia is removing the center of the world educational industry to that continent. For developed economies another challenge is how to attract their schools for internationals. World crises haven't spared any country in

M. Geryk (✉)
Gdansk Management College, Pelplinska 7, 80-335 Gdansk, Poland
e-mail: rektorat@wsz.pl

M. Geryk
Warsaw College of Health and Engineering, Bitwy Warszawskiej 1920 r. 18, 02-366 Warsaw, Poland

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the risk of the shortage of funds for education. The search for a new model of financing higher education institutions is highly demanded by almost all governments around the world.

2 Present State of the Educational Industry

Globalization is a real challenge for the education industry. Having been in constant growth for decades now, the higher education system, mainly in developed economies, is faced with variety of problems. Starting from demographic changes, through labor market turmoil, to the influx of international students.

Due to the popularization and widespread use of the English language, the originally English speaking countries are on the top of the list of countries experiencing the arrival of the highest number of students from other countries. Because of that and because of the strong market recognition of the leading universities, the majority of top ranked schools are from the United States and the United Kingdom, which also increases the demand.

In the majority of universities' rankings, universities are considered as single organizations. But it is almost impossible to appreciate the internal differentiation between academic institutions. It also means that decisions based on those assumptions are always partial and the reader is not given the full spectrum of information [1].

It is not far from the truth to state that universities are, in some cases, acting as firms, when developing entrepreneurial capabilities and strategy autonomy [2]. It corresponds with treating educational institutions as quasi-companies', for they employ people and have a strong influence on the their surroundings [3].

Financial management as well as proper budgeting are the areas difficult to overestimate [4]. They are extremely important and crucial for the existence of every organization, including the university. Budgeting, also, should be seen as a central element in organizational control systems which maintain the required balance between revenues and expenditures [5].

The results of research conducted on twelve Italian universities have proved that efficiency scores differ when university is examined as a whole institution and when separate departments of schools are analyzed. It showed that ranking systems for schools as a whole unit might be exposed to some discrepancies in results [1].

As every organization, higher education institutions are obliged to follow budgetary regimes. The importance of budgeting is widely known [4]. The budgeting itself play an important role in higher education too. University funding usually employs two main approaches: first, resources are directed to an institution as a whole body and then transferred to internal subunits (the core budget), second, resources are allocated to specific projects and subunits (third-party funding). Budgeting can be analyzed from four, different perspectives [6]:

the material side,
the relationship of budgeting to organizational actors,
the procedural perspective,
the relationships to social norms.

The importance of high quality of budgeting in educational institutions is proven by its strong influence on organizations as it is one of their main activities. It also plays an important role when it comes to the relations with stakeholders and the search of resources in an institution's environment. This tool is also helpful in creating a policy for higher education when it comes to the redistribution of public funds to universities as it represents a possibility of higher control over subsidized institutions [6].

The quality of higher education can also be measured by assessing the satisfaction levels of stakeholders. There is a gap between the perception of universities by their internal and external stakeholders. The results of research have showed that students, as external stakeholders, report a lower level of satisfaction, whereas lecturers usually confirmed their higher satisfaction [7]. According to the author of this research, treating students as external stakeholders is questionable. In the author's opinion and according to research, students are an integral part of a university, just like the body of professors, and as such should be treated as internal stakeholders.

The role of stakeholders in improving the quality of university education is crucial. Building such relations also for higher education institutions may benefit them with higher students intake or improved programs and curricula. Higher quality also provide better results in creating intellectual independence [8].

Another qualitative research released at one of the UK universities on the group of 20 interviewees to examine the challenges and issues of the internationalization of higher education brought the conclusion that initiatives to internationalize universities can easily overload academics by overextending their schedules. Actually, this kind of activities are seen as primary for a university, but every action should be cohesive in all the programs offered and across the different departments in order to support the internationalization strategy [9].

The current situation in the UK's higher education system shows an impressive impact of overseas students. With the expansion of the European Union the number of international students from Europe studying in the UK has reached 40 % and further growth is also predicted. Data also indicate that nearly 2/3 of undergraduate programs students pay their tuition fee by themselves, and some 86 % of postgraduates have their fees met from sources outside the UK [10].

Internationalization, in contrary to globalization, represents a positive impact on the world by bringing a variety of ideas and people to exchange. The main issue is that this phenomenon shows respect to the differences between the nations and respect for their traditions [11, 12].

3 Changes (and Challenges) in the Universities Surroundings

Situations involving permanent changes such as environmental changes and demographic ones are one of the major challenges that direct the higher education system towards a more innovative and more efficient model of functioning [13].

Systems of higher education, especially in Europe, are undergoing profound transformations. The changing models of operation lead to higher levels of responsibility for the actions undertaken in the research field as well as in the teaching process and its results [14]. It is connected with organizational autonomy of universities and the independent level of decision making [15].

Institutions from different parts of the globe are nowadays focused on searching for new strategies of development. As an example, the results of research conducted among eight institutions of higher education in Nigeria may be presented. That study led to the discovery that there is a strong positive inter-correlation between administrative strategies and human resources management. Another finding was that only effective human resources management leads to higher performance of both groups, academics and non-academics employed by universities [16].

The example above shows that the higher education policy as well as the strategies implemented by every institution are of a huge interest and are an object of scientific research in many countries, including Nigeria. The findings also provided an important hint that the only way to succeed could be established by strong links between internal stakeholders of a university [6].

In the paper written from the perspective of former Pro-Vice Chancellor and a Head of College at Nottingham Trent University, Ann Priest, concluded that universities play a crucial role for their regions as well as for their nations. The suggestion is that universities should benchmark the organizational achievements of business models, learn and adapt them to the complexity of the university managing process [17].

The universities in the United Kingdom are supposed to be stimulated to develop their business model orientation. The funds for research are in decline and tuition fees, after reforms, are not sufficient. In order to survive, universities seek other strategies for gaining income, such as commercialization and knowledge exchange. Activity of this kind contributed 3.3 billion pounds to the U.K. economy, only in years 2010–2011 [18].

Only by comparison, calculations by the Institute for International Education show that international students injected over $30 billion to the United States economy in 2014, according to data provided by the U.S. Department of Commerce [19]. It only shows why international education could be called an export industry. To reach these numbers, U.S. colleges and universities have enrolled a record high of 974 929 international students in the 2014/2015 academic year. It is worth comparing that with the total number of 20.24 million students in the U.S. in fall 2015. Notice the growth from about 4.9 million in fall 2000 [20]. This achievement represents the highest rate of growth in 35 years, placing the U.S. in the first

position for attracting students from abroad. The international students' share is 4.82 % in total enrollment in U.S. universities and colleges estimated in 2015—20.24 million students, where 5.59 million of them were in private institutions [19].

Another issue of being the first market for international education is social diversity. It is a huge challenge for societies to accept the cultural diversity and to help students from abroad to blend in with the American society. The main issue is to improve and develop cultural competencies and the ethical awareness [21].

Diversity in higher education is often faced with multiracial issues and the improved climate in campuses plays a key role in creating educational outcomes, including multicultural competencies and the adjustment to college life. An important aspect is the open climate for diversity [22]. Research has showed that some students report the feeling of being not accepted by their monoracially-identifying peers [23].

The population of The United States of America is growing, and is estimated today at 323.7 million people [24]. It is worth noting that the U.S. population, only in the period 2000–2010, grew by approximately 27 million people, where the people of color accounted for more than 90 % of this growth [25].

Colleges are expected to prepare all students to effectively engage in an increasingly diverse society. There is even a proposed model—the Integrative Model of Multiracity for a university campus, which may help to improve multiple areas of research and higher education practice so that they could better align multiracially and monoracially-framed initiatives [22].

Other studies have showed that many students are unprepared to work with prospective clients from diverse ethnic backgrounds. The proposed solution is to implement a cultural immersion components in curricula to provide a higher level of understanding of the students' own cultural heritage and its influence on the changing world [21].

Results from another research, focused on students' openness to diversity and challenge, done on the massive population of 8 475 first-year students from 46 institutions, show simply that students who are open to diversity and challenge are more likely to seek out new experiences and to achieve educational success. That's why universities' enrollment offices should foster preferences for students with experience in openness in order to create a positive campus climate [26].

According to the United Kingdom government, The United Kingdom is the second most popular destination for study abroad, after the U.S.A. [27]. Every year more than 430 000 international students from 180 countries choose the UK as their preferred destination for study [28].

Attracting overseas students does not always come in line with a government policy. The research conducted among a group of 46 students from two private London-based colleges could be used as a good example. The law regulates not allowing students outside the EEA to work, even part time, during their studies. The regulation is called 'Tier 4', clearly expressing preferences towards public institutions. What is more crucial, private institutions, contrary to most countries, offer a degree education for a lower tuition fee compared to public ones [29].

It was widely discussed if UK universities replied to this policy positively, but some institutions have succeeded in this field due to their aggressive entrepreneurship orientation, mostly in the knowledge economy [30]. These actions, even if summarized and known as 'university activity', are always provided personally, by academics focused on entrepreneurship. According to Shane, academic entrepreneurship is probably a long-established practice [31].

According to research provided by R. Birds, job roles in the higher education system have been changing towards entrepreneurialism and understanding of the need for innovation. It was also observed that larger institutions create an environment for the entrepreneurial behavior to flourish. Also, a crucial observation was that the key role in this kind of achievements is played by individual actors [32].

The examples cited above may suggest that in some developed markets of higher education, the orientation towards entrepreneurial behavior of university staff and the university itself is considered to be the strategic goal of building an advantage over other institutions.

Some observations after a literature analysis show that UK universities are searching for a balance between decision-making processes and the speed and time required to fully involve academic staff in those processes. It was also indicated that universities nowadays are aware of the prospective tensions that might occur between the market pressure, customers' needs and academic standards requirements. The adoption of higher "market orientation" doesn't exactly mean lowering the quality standards of education [33].

The dynamics of changes in other countries was also an object of scientific research. For example, the way leadership styles align to achieve success in private universities have been analyzed in a Tanzanian case. The results showed that the Catholic University System plays an important role in Tanzanian society. Team work and collaboration were expressed as the source of dynamism. Another source of dynamism was independence from public funds. Most universities are operating based on strong leadership and charisma of the leader. The third dynamics which emerged directly from the study was African culture. All of those dynamisms combined clearly demonstrate that performance of the leaders are highly dependent on academic leadership style [34].

As another research presented, in Nigeria, institutions of higher education wouldn't be able to develop their activities based on public funds only. A close collaboration between universities and industries is required. The industries can assist by financing universities not only in research but also in training by providing the practical side of business in their own areas. A cohesive policy of how both private and public sources might and should finance a higher education processes is recommended [35].

The demographic slump is considered as a threat or challenge not only in Europe. The move from elite to mass education has also created an opportunity for new players. It was noted that even in Hong Kong the number of higher education providers has increased [36].

In a vast majority of American states significant changes in the size of students' enrollment are expected. The process is observed due to the slump in the ethnic

groups with the highest college-going rates—Caucasians and Asian-Americans. The most affected institutions are non-elite, private colleges that rely on traditional enrollment of students from in-state markets [37].

This observation was also confirmed in the Unites States, where private institutions made a great contribution to make higher education available for massive clientele [36]. Other authors observed the same effect in countries like Japan, South Korea and Taiwan R.O.C.—with a growing number of institutions which make studying more massive [33].

Other countries, like, for example, Nigeria, are highly investing in developing their workforce in education, due to its significant contribution to the development of the nation in a wide variety of fields—economical, physical or social. The results of research have led to the conclusion that there is a positive correlation between administrative strategies and human resource management [16]. It means that investment in the quality of staff in tertiary education brings awaited results. This seemingly trivial statement expresses the fact that universities should not only invest in their lecturers and their professional development, but also in their administrative staff as well.

As an example, leadership models in Turkish universities may be used. The most commonly used ones are classic, or traditional, ones, which may lead to rise of the risk of lack of innovation and low level of entrepreneurship. In some institutions under the leadership of this kind, improvements in innovation or entrepreneurship are often not supported. On the other hand, as research shows, that the institutions with new leadership styles, are also more open to innovation. Other results show that 80 % of participants stressed the role of collaboration with representatives of industries, and 78 % stressed that participatory democracy should be an important component of a new leadership model enhancing innovation and entrepreneurship in universities. For 54 % of respondents, it was obvious that an institution should do more to encourage innovation and innovation ideas flowing from the faculty and students [38].

Changes, above all, concern new funding realities, which, almost all over the world, have dramatically reconfigured the system from an elitist one to an egalitarian one [39]. It may also mean that there will be no return to the traditional professor-student model of studying and higher education institutions should grow and change with their students and the other stakeholders.

Internationalization also brings lots of challenges to the global educational industry. As of the year 2013, there have been over 4 million students studying outside their home country [40]. It may hugely benefit the institutions as international students, especially undergraduates, are a massive source of revenue for universities. Those groups of students are financially attractive also in countries where domestic students are not subjected to pay tuition fees but students from overseas are. That situation occurs in Sweden or in Poland (in state universities on full-time programs). In other countries, like Australia or the UK, international students are charged a premium fee [41].

In Canada, as data collected by the Association of Universities and Colleges of Canada shows, in 2006 there were 70 000 full-time and 13 000 part-time

international students. The international students account for 20 % of the total enrollment for undergraduate programs in the whole of Canada. What is characteristic, in 2006, only 2.2 % of Canadian students decided to study abroad, and that is still more than double the amount from 2000 [42].

As the results of research show, the process of internationalization in Canada has also its problems. One of them reflects the treatment of internationalization as a factor which improves business opportunities and marketing strategies. Another one is that universities mainly focus on the needs of undergraduates, leaving the needs of graduate students from abroad with a feeling of being ignored. There was also noticed a discrepancy between the everyday reality and practice in international students enrollment and the official universities' strategies [43].

As the market of international students is still growing, new players come to stage. Countries like China [44], France [45], Japan [46] and the United Kingdom [47] are trying to attract more international students, mainly the most profitable ones—undergraduates.

Research conducted in 151 U.S. public institutions offering doctoral programs (88 % of institutions of this type in the U.S.) and in 329 schools and colleges with bachelor and master's programs (81 % of the total) has led to the conclusion that universities may generate additional tuition revenue by reconfiguring their market orientation, switching into a more internationalized one, avoiding the increase in the number of the students enrolled. It is also predicted that universities will move into more profitable areas focusing their future goals on a higher level of return on investment [48].

On the basis of a report about the perspectives for students' enrollment it is observed that colleges have three basic business models for attracting and keeping students. The market position of the most elite colleges will remain stable, as the demand for a brand-name degree will remain higher than the supply. Their only weaknesses are exorbitant tuition fees and a wide list of well-known names of professors who spend little time with students. The model for for-profit colleges and community colleges is also strong. Their main base of students are older students, searching for more flexible programs to fit their schedules. The weaknesses are too large classes and their inability to provide enough courses to fully satisfy their students. Also, for-profit colleges are expensive, and their graduates have much higher debts in comparison to graduates of other colleges. The third group are schools in the middle of the stake. They offer programs mostly for the fast-growing age group of 18–24 year olds. This population is now in a predicted decrease. That group of colleges has been stuck with the same business model for decades as it guaranteed a stable growth and market position. Currently, some colleges expose themselves to risk by giving away their product with a 40 % discount.

The prospective students of 2020 will demand an education on their terms, with more customized and technology-based approaches. Stronger orientation on practical skills enhancing a student's chance to enter a chosen career will be necessary. To compete for students, a re-imagination of colleges is needed. Schools should be more convenient and more open to help students in creating their own career paths [49].

References

1. Agasisti, T., Bonomi, F.: Benchmarking universities' efficiency indicators in the presence of internal heterogeneity. Stud. High. Educ. **39**(7), 1237–1255 (2014)
2. Whitney, R.: The university in the market. Portland Press, London (2008)
3. Crane A., Matten D.: Business Ethics. Managing Corporate Citizenship and Sustainability in the Age of Globalization. Oxford University Press, Oxford (2007)
4. Wildavsky, A.: Budgeting. A Comparative Theory of Budgetary Process. Transaction Publishers, New Brunswick (2002)
5. Pfeffer, J., Salancik, G.R.: Organizational decision making as a political process: the case of a university budget. Adm. Sci. Q. **19**(4), 135–151 (1974)
6. Lepori, B., Usher, J., Montauti, M.: Budgetary allocation and organizational characteristics of higher education institutions: a review of existing studies and a framework for future research. High. Educ. **65**(1), 59–78 (2013)
7. Abidin, M.: Higher education quality: perception differences among internal and external stakeholders. Int. Educ. Stud. **8**(12), 185–192 (2015)
8. Baird, J.R.: Quality: what should make higher education "higher"? High. Educ. Res. Dev. **7** (2), 141–152 (1988)
9. Jiang, N., Carpenter, V.: A case study of emerging challenges and reflections on internationalization of higher education. Int. Educ. Stud. **7**(9), 56–68 (2014)
10. Böhm, A., et al.: Vision 2020: Forecasting International Student Mobility a UK Perspective. British Council, London (2004)
11. Currie, J.M., DeAngelis, R., de Boer, H., Huisman, J., Lacotte, C.: Globalizing Practices and University Responses: European and Anglo-American Differences. Praeger, London (2003)
12. Gacel-Ávila, J.: The internationalisation of higher education: a paradigm for global citizenry. J. Stud. Int. Educ. **9**(2), 121–136 (2005)
13. Labib, A., Read, M., Gladstone-Millar, Ch., Tonge, R., Smith, D.: Formulation of higher education institutional strategy using operational research approaches. Stud. High. Educ. **39** (5), 885–904 (2014)
14. Kruecken, G., Meier, F.: Turning the university into an organizational actor. In: Drori G.S, Meyer J.W., Hwang, H. (ed.) Globalization and Organization. Oxford University Press, Oxford (2006)
15. Kruecken G.: A european perspective on new modes of university governance and actorhood. Research & Occasional Paper Series, CSHE17.11, University of California, Berkeley (2011)
16. Osakwe, R.N.: Administrative strategies of departamental heads as determinants for the effective management of human resources in tertiary institutions in delta state, Nigeria. High. Educ. Stud. **5**(1), 43–50 (2015)
17. Priest, A.: The challenge of managing a large university in conditions of uncertainty. London Rev. Educ. **10**(3), 275–288 (2012)
18. Higher education funding council for England: UK universities contribute to economic growth (2012) http://www.hefce.ac.uk/news/newsarchive/2012/Name,94186,en.html
19. Institute of International Education: Open Doors: Report on International Educational Exchange http://www.iie.org/Who-We-Are/News-and-Events/Press-Center/Press-Releases/2015/2015-11-16-Open-Doors-Data#.Vxdr20vGo4c (2015)
20. National Center for Education Statistics, http://nces.ed.gov/fastfacts/display.asp?id=372
21. Jaoko, J.: Study abroad: enhanced learning experience in cultural diversity. Coll. Q. **13**(4), 1–7 (2010)
22. Guliermo-Wann, Ch., Johnston, M.P.: Rethinking research on multiracial college students: toward an integrative model of multiraciality for campus climate. Paper presented at the 2nd Critical Mixed Race Studies Conference (2012), http://eric.ed.gov/?id=ED538027 (2012)
23. Renn, K.A.: Mixed Race Students in College: The Ecology of Race, Iidentity, and Community. Suny Press, Albany, NY (2004)
24. http://www.worldometers.info/world-population/us-population/

25. Humes, K.R., Jones, N.A., Ramirez, R.R.: Overview of Race and Hispanic Origin: 2010. U. S. Census Bureau, Washington, DC (2011)
26. Bowman, N.A.: Conceptualizing openness to diversity and challenge: its relation to college experiences, achievement, and retention. Innov. High. Educ. **39**(4), 277–291 (2014)
27. The UK Government: International Education Strategy: Global Growth and Prosperity https://www.gov.uk (2013)
28. The UK Council for International Student Affairs: International Students Statistics: UK Higher Education http://institutions.ukcisa.org.uk//Info-for-universities-colleges–schools/Policy-research–statistics/Research–statistics/International-students-in-UK-HE/ (2015)
29. Mughal, A.W.: Investigating the impact of the tier 4 policy on international students at private colleges in the UK. J. Int. Students **6**(1), 241–261 (2016)
30. Clark, B.R.: Sustaining Change in Universities: Continuities in Case Studies and Concepts. Open University Press, Maidenhead (2004)
31. Shane, S.: Academic Entrepreneurship: University Spinoffs and Wealth Creation. Edward Elgar, Cheltenham (2004)
32. Birds, R.: Entrepreneur-managers in higher education: (how) do they exist? J. High. Educ. Policy Manag. **36**(1), 62–73 (2014)
33. Pitcher, G.S.: Managing the tensions between maintaining academic standards and the commercial imperative in a UK private sector higher education institution. J. High. Educ. Policy Manag. **35**(4), 421–431 (2013)
34. Vumilia, P.L.: How leadership styles in academia align to achieve success within the Tanzanian catholic universities system. Int. J. High. Educ. **4**(4), 53–63 (2015)
35. Asiyai, R.I.: Improving quality higher education in nigeria: the roles of stakeholders. Int. J. High. Educ. **4**(1), 61–70 (2015)
36. Kember, D.: Opening up the road to nowhere: problems with the path to mass higher education in Hong Kong. High. Educ. **59**(2), 167–179 (2010)
37. Noel-Levitz: Back to the present: strategic enrollment planning for the coming demographic change. Coralville, Iowa (2010) http://eric.ed.gov/?id=ED536850
38. Sart, G.: The new leadership model of university management for innovation and entrepreneurship. Eurasian J. Educ. Res. **57**, 73–90 (2014)
39. ASHE Higher Education Report: Setting the Stage: Funding Realities and Talent (2012). doi:10.1002/aehe.20001
40. OECD: Education at a glance 2013, OECD Publishing, Paris http://dx.doi.org/10.1787/eag-2013-en (2013)
41. Johnstone, D.B., Marcucci, P.N.: Financing Higher Education Worldwide: Who Pays? Who Should Pay?. The Johns Hopkins University Press, Baltimore, MD (2010)
42. AUCC: Trends in Higher Education: Enrollment, vol. 1. Association of Universities and Colleges of Canada, Ottawa, ON (2007)
43. Guo, S., Chase, M.: Internationalisation of higher education: integrating international students into canadian academic environment. Teach. High. Educ. **16**(3), 305–318 (2011)
44. McCafferty G.: China in Soft Power Push with Foreign Students. CNN http://edition.cnn.com/2013/05/29/world/asia/china-soft-power-foreign-students (2013)
45. Marshall J.: Reforms Aim to Attract More Foreign Ph.D. Students. University World News, no. 272 http://www.universityworldnews.com/article.php?story=20130517105000290 (2013)
46. Shao C-F.: Japanese polices and international students in Japan, http://artsonline.monash.edu.au/mai/files/2012/07/chunfenshao.pdf (2012)
47. Buchanan, R.T.: 100,000 more international students in the next five years. In: The Independent http://www.independent.co.uk/student/news/100000-more-international-students-in-the-next-five-years-8736696.html (2013)
48. Cantwell, B.: Are international students cash cows? examining the relationship between new international undergraduate enrollments and international revenue at public colleges and universities in the US. J. Int. Students **5**(4), 512–525 (2015)
49. Van Der Werf, M., Sabatier, G.: The College of 2020: Students. Chronicle Research Service, Washington, DC (2009)

A Study of Satisfiers and Dissatisfiers for Japanese Students in Extracurricular Activities

Yutaka Nakajima, Naoto Shoji, Takumi Iwaasa and Motoki Mizuno

Abstract In Japan, several study have shown that satisfaction with extracurricular activities for junior and high school students influences satisfaction with their school life. However, there are some possibilities in satisfaction factors between junior and high school students. We conducted a study to clarity the differences in satisfaction factors (satisfiers) and dissatisfaction factors (dissatisfiers) for the students in extracurricular activities. However, there are little theories about their satisfiers and dissatisfiers. Here, we applied Herzberg's "Motivation-Hygiene theory" to our specific area of extracurricular activities. It has been shown that bad "supervision-technical" is likely to cause junior high school students' dissatisfaction, whereas not so for high school students.

Keywords Extracurricular activities · Satisfiers and dissatisfiers · Junior and senior high school students · Motivation-Hygiene theory

1 Introduction

In japan, extracurricular activities are ordinary activities and regarded as ongoing educational activities that most students in junior high school (age 13–15) and high school (age 16–18) take part in after school every day. Both junior high and high school have high participation rate. Approximate 90 % of junior high school students and Approximate 70 % of high school students join extracurricular activities [1]. In the activities, the students engage in many sports (e.g. baseball, soccer, tennis, track and field) and in many cultural (except for sports) activities (e.g. orchestra, art, drama, chemistry).

Y. Nakajima (✉) · N. Shoji · T. Iwaasa · M. Mizuno
Juntendo University Graduate School of Health and Sports Science, Chiba, Japan
e-mail: nkjmytk92@yahoo.co.jp

M. Mizuno
Juntendo University School of Health and Sports Science, Chiba, Japan

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It has been shown that satisfaction with extracurricular activities has effects on school life [2] and on acquiring life skills [3, 4] for junior and high school students. Hence, it is very important to explore satisfaction factors (satisfiers) and furthermore, dissatisfaction factors (dissatisfiers) for the students in extracurricular activities. However, there are high possibilities of some differences in the activities between junior and high school students because of traits and disposition, etc. Moreover, little theories have not been implemented about the satisfiers and dissatisfiers.

However, in the field of industrial/organizational psychology, Herzberg [5] proposed "Motivation-Hygiene theory". The theory states that there are certain positive factors (e.g. achievement, recognition, work itself, responsibility) in the workplace that cause job satisfaction (i.e. satisfiers), while some negative factors (e.g. company policy, supervision-technical, relationship with other people, salary) cause job dissatisfaction (i.e. dissatisfiers). In other words, dissatisfiers will not provide satisfiers, nor will satisfiers eliminate dissatisfiers (Fig. 1).

Herzberg, F (1987): One More Time: How Do You Motivate Employees? Harvard Business Review, 65(5), September–October, p 112.

We applied Herzberg's theory to our study on specific area of extracurricular activities. The purpose of this study was to consider the differences between

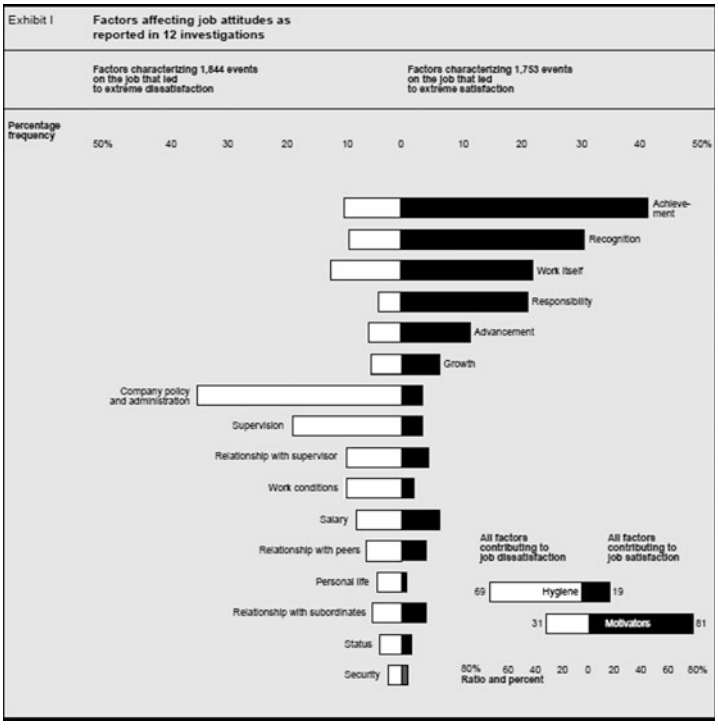


Fig. 1 Motivation-hygiene theory

satisfiers and disssatisfiers for Japanese junior and high school students in extracurricular activities from the perspective of this theory.

2 Methods

2.1 Participants

We carried out the questionnaire investigation in 2015. The participants were 96 students, 70 junior and 26 high school students in a city in Chiba prefecture, Japan (Table 1).

2.2 Measurements

The questionnaire consisted of two sections. The first of which was a face sheet. In this, we explored demographic information of the participants (e.g. kinds of school, grade, sex, extracurricular activities). In the second, the participants described a time (event) when they felt exceptionally "good" and felt exceptionally "bad" about their extracurricular activities.

2.3 Analysis Method

We carried out analytical works by following the steps described below. First, in applying the theory of Herzberg, we had to modify to fit the items of Herzberg's theory in this specific area of extracurricular activities. In this study, however, the number of factors which influences satisfiers or dissatisfiers is fifteen, while that of the theory is sixteen. This is because extracurricular activities have two types of "relationship with other people": "relationship with supervisor" and "relationship

Table 1 The detail of the participants

		Junior high school students			High school students		
		7th	8th	9th	10th	11th	12th
Sports activities	Male	10	6	15	5	2	2
	Female	8	11	12	4	4	0
Cultural activities	Male	0	0	0	3	0	0
	Female	2	1	5	1	5	0

with member of the activities", whereas enterprises have three types: "with supervisor", "peers", "subordinates". In addition, instead of "salary", we called it "reward" because "salary" does not exist in educational context. We called this fifteen factors "Motivation-Hygiene 15 Factors for Students in Extracurricular Activities" (hereinafter referred to as "M-H15Fs"). Second, we categorized the data into M-H15Fs for satisfiers and dissatisfiers and obtained 286 data, satisfiers (158) and dissatisfiers (128). Finally, to examine the rate the participants pointed M-H15Fs as satisfiers or dissatisfiers, we calculated the ratio of the data.

3 Results

3.1 Satisfiers for Junior and High School Students

As Fig. 2 describes, junior high school students responded to the following factors as satisfiers; achievement (77.14 %), recognition (30 %), growth (21.43 %), relationship with member of extracurricular activities (15.71 %), activities itself (11.43 %), responsibility (2.86 %), relationship with supervisor (1.43 %). On the other hand, high school students responded the following factors as satisfiers; achievement (65.38 %), recognition (30.77 %), growth (23.08 %), relationship (M) (15.38 %), activities itself (11.54 %), personal life (3.85 %), reward (salary) (3.85 %). No data were applied to advancement, activities policy and management, supervisor-technical, activities condition, status, security.

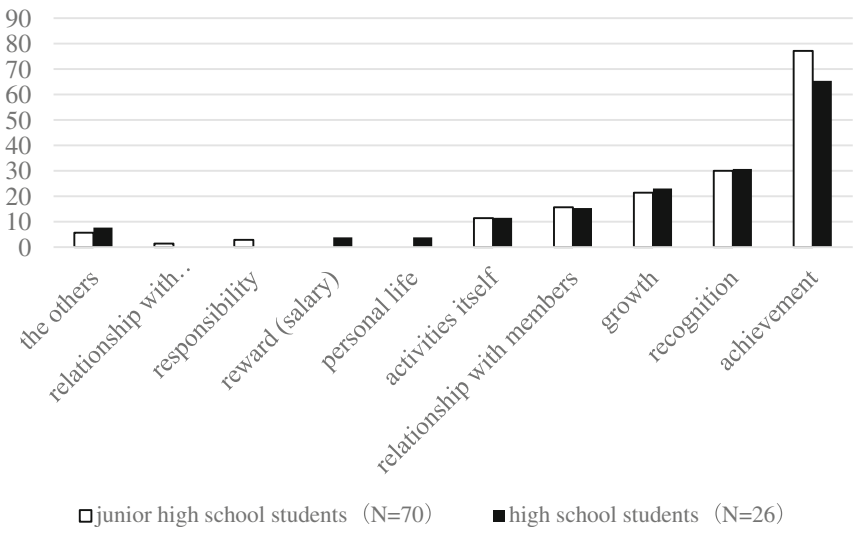


Fig. 2 The ratio of the number of the data included in M-H15Fs responded as satisfiers

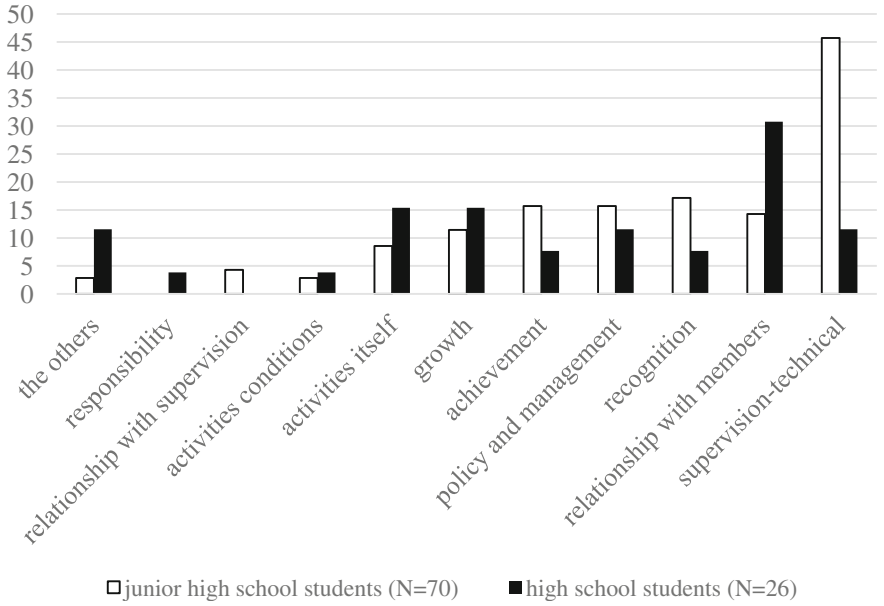


Fig. 3 The ratio of the number of the data included in M-H15Fs responded as dissatisfiers

3.2 Dissatisfiers for Junior and High School Students

As Fig. 3 describes, junior high school students responded the following factors as dissatisfiers; supervision-technical (45.71 %), relationship with member of extracurricular activities (14.29 %), recognition (17.14 %), activities policy and management (15.71 %), achievement (15.71 %), growth (11.43 %), activities itself (8.57 %), activities conditions (2.86 %), relationships with supervisor (4.29 %). On the other hand, high school students responded the following factors as dissatisfiers; supervision-technical (11.54 %), relationship with members of extracurricular activities (30.77 %), recognition (7.69 %), activities policy and management (11.54 %), achievement (7.69 %), growth (15.38 %), activities itself (15.38 %), activities conditions (3.85 %), responsibility (3.85 %). No data were applied to advancement, reward, personal life, status, security.

4 Discussion

This study examined the differences between satisfiers and dissatisfiers for Japanese junior and high school students in extracurricular activities.

In the satisfiers, there were no significant differences between junior and high school students. Both types of students responded achievement, recognition and

growth. In particular, achievement accounted for an overwhelmingly high rate. This results showed that extracurricular activities-related factors strongly influence the satisfaction in extracurricular activities for both types of students.

In the dissatisfiers, there were large differences between junior and high school students. Especially, it is worthy of notice that 46 % of junior high school students responded supervision-technical as dissatisfiers, whereas the percentage of high school students was 12 %. It was thought that the difference was influenced by the second period of rebellion, as is also referred to as "teen rebellion". It is generally appeared in adolescence during the age 13–16. Therefore, junior high school students are likely to take a defiant attitude toward adults such as their leader of extracurricular activities. Most data in "recognition" responded by junior high school students were "the leader got mad/yelled at me". Furthermore, in "supervision-technical", there were also some data which related to "the leader got mad/yelled at me". Thus, this finding implies a possibility of relationship between "supervision technical" and "recognition". Although there was an obvious difference in extracurricular activities between two types of students, it is difficult to interpret it because hardly any researches which focused on extracurricular activities have definite views on relationship with team mates. Therefore, little attention have been paid for motivation for students. For example, Aoki [6] and Inaji [7] showed that relationship with other people caused leaving the activities, whereas self-determination theory, which is popular in phycology, states that relationship with other people influences the motivation. In this regard, it is necessary to expand the further study.

5 Conclusion

We concluded that the results of this study provide leaders in extracurricular activities with effective instructional methods. In order to give students the satisfaction, they should have many opportunities for improving students' technique and performing their ability. Moreover, it is also important for leaders to compliment the students as they make progress. On the other hand, not to give students dissatisfaction, taking the second period of rebellion into account and suitable instruction are required. As stated above, leaders have to be especially conscious of their behavior and interaction of junior high school students. Thus, they should refrain from getting mad and yelling at their students without rational reason.

References

1. Benesse Educational Research and Development Institute http://berd.benesse.jp/berd/center/open/report/houkago/2009/soku/soku_14.html, Mar 22, 2016 (2008)

2. Yoshimura, H.: Human interactions in extracurricular athletic clubs in relation to adjustment members—The importance of self-assertion. Jpn J Phys. Educ. **45**(3), 337–345 (1997)
3. Ueno, K., Nakagomi, Shiro: A study on the acquisition of life skills through the participation in athletic club. Jpn J Phys. Educ. **43**(1), 33–42 (1998)
4. Ueno, K.: Relationship between acquisition of goal-setting skill and time perspective through participation in athletic clubs. Jpn J Phys. Educ. **51**(1), 49–60 (2006)
5. Herzberg, F.: Work and the Nature of Man. The World Publishing Company, Cleveland (1966)
6. Aoki, K.: Factors affecting senior high school athletes' keeping in or dropping out of their sport team activities. Jpn. J. Phys. Educ. **34**(1), 89–100 (1989)
7. Inaji, H., Shenda, T.: A study on dropping out in junior-high school sport team activities: The factors of dropping out and the estimated scale for dropping-out (ESD). Jpn J Phys. Educ. **37**(1), 55–68 (1992)

Part IX
Training, Organizational and Team Learning

Effective Use of Group Projects in Online Learning

Robert Ekblaw

Abstract Group projects have long been used in face-to-face instruction to improve cognitive learning among its students. Group projects not only provide practical experience and allow students to practice the concepts they have learned, but also teach the students creative construction and group dynamics. As important as group projects have proven in conventional learning, they are rarely used in online education courses. This paper examines the foundations of effectively using group projects, and then demonstrates how to integrate them into online learning courses.

Keywords Collaborative learning · Group projects · Distance learning

1 Introduction

Teamwork and group projects have found to be an effective tool for teaching higher-level cognitive functions. Students learn to incorporate disparage ideas and meld them into a single solution, while simultaneously learning to work and communicate within a group in a constructivist environment [1]. It has become a popular teaching method for higher education and advanced topics in secondary education. However, as higher education has increased its use in online courses, whether to increase enrollment, reduce faculty costs, or both, the propensity of group projects has reduced.

Why is that? It seems that many instructors believe that it is difficult to properly implement group projects and teamwork when the participants are scattered geographically and unable to meet face-to-face [2]. An important factor to the success of project teams is effective communication [3], and many instructors feel that communication is much more difficult when the students cannot meet in person. Since instructor oversight is also a crucial factor in the success of group projects [3],

R. Ekblaw (✉)
Hudson Valley Community College, Troy, NY, USA
e-mail: r.ekblaw@hvcc.edu

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their own difficulty communicating with remote students might also factor into the hesitation.

But does geographical separation really prevent effective communication? With the myriad of online and electronic communication methods, couldn't effective communication still drive group project teams? It might look different than the face-to-face communication and construction methods that dominated group projects in secondary education, but it could still be done.

We will examine that question, and determine the best methods of supporting effective teamwork in online group projects. We start with examining advances, experiments, and advice in literature. From there, we examine the methods and techniques of effective teamwork and communication, as well as tools to support online collaboration. We then propose a structure, or template, for designing an effective team-based project. Lastly, we conclude by examining what we have accomplished so far and what future research might unearth.

2 Literature Review

There have been several papers written about effective team projects in learning, although most of them focus on face-to-face learning. We'll examine these articles in an organized fashion, starting with the formulation of teams.

The formulation of teams is a crucial stage in project-based learning [4]. The stronger the group, the better the result. Nearly all of the papers and researchers state the importance of having the instructor create the groups, instead of having the students choose their group mates. Careful selection of the group members helps ensure proper distribution and balance of skills and work ethic [4]. Obviously, for the instructor to make an appropriate selection, he or she must have knowledge of the background, knowledge, and experience of the students. There are a variety of methods used to determine that information: a pre-test, a survey administered at the start of the course, case and course histories, and personal biographies. The importance of distributing the skills and methods of the group members allows for more interaction and broader investigation [4].

Once the teams are created, there is still preliminary work to be done before the actual project begins. The teams should be trained in team building and cohesion skills. Practice exercises are one of the best ways to educate them in group skills [4]. The teams should also be trained in design methods, especially for technological or scientific projects like those in Computer Science, Electrical Engineering, Biomedicine, or similar studies [5]. This not only gets all of the team members involved at the very beginning, but also provides focus and identifies potential problem areas.

It is also important for the teams to understand the difference between cooperation and collaboration. Cooperation is where the multiple tasks of a project are divided among the team members, but each person works independently. Collaboration is the process where the finished product is produced via interactions

among all of the members of the group working together [5]. True training in teamwork will come from collaboration, not cooperation. Collaboration has also been found to produce the advances in cognitive learning desired by project-based learning [5].

Once the teams are created and properly prepared, the instructor still has work to do. It is the instructor's responsibility to ensure that the teams are functioning effectively. Part of that is looking for any missing characteristics that define an effective team.

What are those characteristics? While all papers had some slight differences, most of them agreed on the following:

1. Common goal [6]: all team members agree on the final product and the process to create it
2. Organization: the team assigns roles and responsibilities to have everyone participating. For long-term projects, those roles can be switched among the team members [7]
3. Group consciousness: each team member has the awareness that they are part of a team, and what they do can effect others. This characteristic includes respect for the other team members [7] and trust in the other team members [6]
4. Effective communication and interactions: the team members have a smooth means of sharing ideas and producing results
5. Cohesion [6]: The team members develop a smooth and effective process that allows them to function with little or no intervention; self-motivation and mutual support are a part of this characteristic

These characteristics address the main reasons group project teams fail, according to surveys conducted by students [6]. The primary reasons are disorganization, unclear objectives, separated or fragmented group members, lack of motivation, and conflicts among group members. Properly prepared and structured teams deal with all of those items except motivation and conflict resolution, both of which will be discussed later in this section.

Just designing and supporting the team to have the right characteristics is not enough. There are key behavioral factors that must be operating to support team cohesion and effectiveness [7]. These keys are:

1. Cooperation: Positive interdependence is achieved when members of the team rely on each other to complete the project. They understand that their individual success is inherently linked with that of their other team members and with the success of the team as a whole.
2. Accountability: Individual accountability means that each team member is held responsible for his or her contribution to the completion of the project.
3. Encouragement: Promotive interaction implies that group members recognize the contribution of others in the team and give positive feedback for their accomplishments. They encourage each other towards the successful completion of their tasks.

4. Communication: Appropriate use of social skills is necessary because interpersonal and small group skills are critical to team success.
5. Analysis: Through group processing techniques, team members reflect on how well their team is functioning.

Most authors in the literature encourage the use of functionary roles to have each member of the group contributing to the cohesion. While specific roles differ, the most common ones are a Team Leader, a Scribe, a Facilitator, and a Liaison [7]. The Team Leader's role is rather obvious. This is the person who keeps everyone on track and on schedule. The Scribe is the note taker for meeting, and also the "consolidator", or the person to produce the final end result, if the group is producing a written end result and have difficulty (or can't use) a shared document that allows the ability to "collapse" or integrate separate updates.

The Facilitator is used in brainstorming and problem solving sessions. This person moderates the conversation and ensures everyone participates. The Facilitator is often the person who initially attempts to resolve conflicts among group members, especially if the Team Leader is one of the people engaged in the conflict.

The Liaison is an interesting role. It is not always used, but is finding more prominence among project-based learning, especially ones designed to get assistance from remote sources. The Liaison is the person who maintains contact with external resources, like professional advisors or colleagues at other locations. Instead of being swarmed by every member of the group, this one person gathers the information or questions desired by everyone and brings those items to the external contact.

It's easy to say that we want to have effectively-running project teams, but what does it mean to be effective? The literature addresses that, too. While there is no universal measures, there are four items that most of the experts feel are crucial success measures: effectiveness, efficiency, satisfaction, and achievement [3]. Effectiveness simply measures whether the team fulfilled on their goals. Efficiency measures how quickly they could resolve issues and research key information. Satisfaction measures how pleased the group members are with their process, and achievement measures what the students learned during the project.

To fulfill on these measures, and be an effective team, there are several common problems that the instructor should be attentive to, and support the teams in resolving them. Those problems are [8]:

1. Student apathy
2. Lack of group or social skills
3. Free riders, those group members who don't want to do the work but get the same grade as everyone else
4. Imbalance or inequality of ability; some group members seem naturally more capable than others
5. Poor distribution of roles and responsibilities
6. Ignoring some group members, or some just stop participating
7. Conflict among team members

So what can be done to alleviate these problems? As suggested by Roberts and McInnerney [8], student apathy can be resolved with any combination of the following: developing rapport with games or exercises, providing personal motivation like extra credit or other bonuses, and promoting the value of the assignment. The lack of group or social skills can be handled by additional training (either in class or outside) or small assignments that build a social presence (like discussion board posts or weekly journals). Free riders have to be identified and encouraged to participate. If they don't, they are appropriately punished with a lower grade or extra work. A reward system also works well for a skill imbalance, only this time reward team members for applying extra effort. Then those who work hard to improve themselves will gain the reward.

The next two problems can only be effectively handled by monitoring the groups' progress [8]. The instructor must maintain contact with the team, ideally through more than one person (like the Team Leader AND the Liaison), to ensure that everyone is participating and that roles and responsibilities are appropriately and equally apportioned.

Conflict Resolution is widely regarded in the literature as an important skill in effective group projects. While all instructors hope that their student groups will smoothly operate with no personal conflicts, they realize that is an unrealistic hope. It is best to prepare your groups for resolve conflicts by conducting a workshop, even a role-playing exercise, before beginning the project [7]. The general advice provided in such exercises seems fairly universal:

1. Keep the conversation focused on the common goals and group interests. Prevent personal opinions.
2. Maintain a sense of calm. Once people get angry and raise their voice, rationality disappears and emotions run high.
3. Use personal statements ("I feel like…") instead of accusatory statements ("You tried to hurt me.")
4. Listen to both sides of the disagreement before rushing to judgement.
5. Look for a compromise that satisfies everyone. Don't play favorites or "whose turn is it to win?"

The Conflict Resolution Consortium at the University of Colorado-Boulder provides some more detailed advice [9]. According to them, the first priority is to restore group cooperation and cohesion. Try to see the other person's point of view. You don't have to agree with him or her, but don't simply say, "You're wrong" or "Get over yourself." Listen to the person's fear, and then attempt to diffuse them. Often their fears are what are controlling the situation, and calming them will soothe them and allow for a smoother conversation. A similar process can be done for any intense emotions that erupt. You can acknowledge that someone has gotten excited ("I can see that this is very intense for you.") and then encourage them to discuss the source of those feelings. This helps diffuse it by dealing with the CAUSE of the emotions instead of the emotions themselves.

The University of Melbourne Law School has some additional points [6]:

1. Identify the cause of the conflict
2. Distinguish how the conflict affects the team and the task
3. Brainstorm a solution that does not hurt anyone, benefits as many group members as possible, and furthers the group's common goals
4. Agree on the steps to take to resolve the conflict and implement the solution
5. Document the process and the proposed solution. This prevents anyone from later saying that the conflict wasn't really resolved.

3 Tips for Effective Teamwork

As a participant, and later a coach, for the Team Management and Leadership Program (TMLP), I have seen what promotes a group of diverse personalities and experiences merge into a highly effective team. Many of the successful aspects of the TMLP apply to project-based learning, as reflected in the literature.

The first, and most crucial, step is called "Background of Relatedness." It is nearly impossible to get a group of strangers to smoothly work together. It is important for group members to bond over familiar and shared experiences or interests [10]. This can be handled by having them share personal stories on Facebook or a private Discussion Board. Allow them to create threads based on personal interests, so that they can see how many other students share their interests.

Once they know each other, the next step is easier. They should create a clear and measureable result. All members of the group should agree on the final result, and it should have specific parts and aspects that can be visibly seen. This allows the group members to determine when they are done, because it contains everything they intended [11].

Once a clear intended result is visible, the group members can determine the process to fulfill on that intention. They should get specific, and prioritize items in chronological order [11]. These items should be specific, detailed, and small. It doesn't matter if you have many of them. Keeping it simple allows each individual task to be easily understood and achieved [10].

The group members should report the completion of tasks to the Group Leader, who maintains a checklist, calendar, or other means of tracking the project [10]. It is important for the Group Leader to have a clear picture of what has been accomplished, what remains to be accomplished, and what items might be falling behind. The Group Leader should communicate the progress to the rest of the team frequently (in class environments, that means at least twice a week) and the group members should communicate their progress just as frequently.

As tasks are completed, the Team Leader should acknowledge the group members for their efforts, and even periodically reward them for their efforts. This maintains the students' motivation and creates a sense of accomplishment that is crucial to their self-esteem.

4 Tips for Collaboration

The intent of many of these group projects, especially in higher education, is to promote collaboration [12]. For collaboration to be effective, there are key skills necessary: interpersonal and social skills, group management skills, and inquiry skills. Inquiry skills include the ability the clarify information, infer missing information from existing data, and judge what information is most crucial or most appropriate [12]. To build social skills, many experts suggest having the students share accomplishments or success stories each week as the project progresses [13].

Building these skills require examples, class exercises, and "best practices" pointers [13]. These exercises should allow the students practice both levels of collaborative interaction. Low-level interaction involves activities like clarifying facts using defining questions, identifying the limits or boundaries of information, accepting and integrating information, declaring facts., and evaluating information [12]. High-level interactions involve presenting and examining alternatives, questioning ideas, cognitive elaboration and explanation, and organizing information.

5 Online Collaboration

With today's technology, it is thought that collaborative group projects can now be done easily, as information and technical experts are only a mouse click away. However, the use of online collaboration carries its own challenges, and it is important that instructors are aware of those when planning online collaboration projects [2]. These challenges are:

1. Different schedules, work pace, and time zones
2. Impossible face-to-face opportunities
3. Secure file sharing
4. Different computer platforms or applications
5. Different file formats

The greatest challenges involved in the use of online tools for collaboration are the diversity of technology and distance of the group members. Some may be part-time students who work full-time. Some may be in time zones as much as five or six hours apart. Arranging a mutually-available time for the group members to speak in person can be difficult.

The most common communication tools are email, discussion forums, text messages or instant messaging, online conference tools like GoToMeeting, blogs, and wikis. These are good for sharing ideas, but cannot be used to produce the end result. This limitation often causes them to use online tools for building the end result.

If the online tool has its own design and packaging, the use of an online tool to share ideas and build the product can move smoothly. However, most students simply use a file sharing program like Google Docs or Dropbox. This can cause serious problems.

Many online file sharing tools are only repositories. They can hold files of any type. There is typically one version of the file (unless the users themselves maintain historical copies). The file is downloaded, edited, and then uploaded again. There is no control to prevent two people from downloading the same file and uploading two different versions, thus losing the information added by the previous updater. File updates must then be carefully monitored and handled by one team member exclusively.

To bypass this, some teams might use an application like MS Word that can track changes. Thus, each member of the group can approve any changes before they are integrated into the document. This can have problems, too. The different group members might have different versions of the Microsoft Word application, which would use the Track Changes differently. Worse, if any team member has a Mac or Unix system instead of a Windows system, the application used to read MS Word documents (like Open Office) might not track changes at all, or mark them differently.

To alleviate this, the instructor should investigate appropriate online tools. The instructor would look for ones that manage documents or files itself, or ones that are operating system independent. After testing these tools, the instructor would then suggest that the students use them. In this fashion, the instructor can ensure that everyone is using the same tools, and prevent the problems that can occur from inconsistent or incompatible applications.

6 Conclusion

Project-based learning and group work are valuable tools for education. They teach teamwork and group dynamics, encourage a deeper and broader understanding of the course material, and foster higher-level cognitive abilities. However, these results can be hindered if the project and the student teams are not properly prepared and supported. The students must be prepared for how to effectively work in teams, and provided with the same online tools that facilitate sharing their ideas and formulating their end product.

Once student teams are created, they should be monitored and observed to ensure that the characteristics and keys of effective leadership and collaboration are present and working. Any disputes or conflicts should be resolved quickly, before it shatters the cohesiveness of the work group.

References

1. Tarricone, P., Luca, J.: Successful teamwork: a case study. In: Higher Education Research and Development Society of Australia Proceedings, pp. 640–646 (2002)
2. Whatley, J., Beer, M., Staniford, G.: Facilitation of online student group projects with a support agent. In: Proceedings of the Autonomous Agents Workshop on Agents Supporting Cooperative Work (2001)
3. Hoegl, M., Gemuenden, H.G.: Teamwork quality and the success of innovative projects: a theoretical concept and empirical evidence. Organ. Sci. **12**(4), 435–449 (2001)

4. Collaborative Learning: Group Work, Cornell University Center for Teaching Excellence, http://www.cte.cornell.edu/teaching-ideas/engaging-students/collaborative-learning.html
5. Paulus, T.M.: Collaborative and cooperative approaches to online group work: the impact of task type. Distance Educ. **26**(1), 111–125 (2005)
6. University of Melbourne Law School http://www.law.unimelb.edu.au/lasc/professional-skills/tips-for-effective-teamwork
7. Abarca, J.: Introductory Engineering Design: A Projects Based Approach, pp. 39–54. IEEE, Boston (2002)
8. Roberts, T., McInnerney, J.: Seven problems of online group learning (and their solutions). Educ. Technol. Soc. **10**(4), 257–268 (2007)
9. Burgess, H., Beyond Intractability http://www.beyondintractability.org/ educationtraining/group-projects
10. eLearners http://www.elearners.com/online-education-resources/online-learning/how-to-survive-virtual-group-work/
11. Oakley, B., Felder, R., Brent, R., Elhajj, I.: Turning student groups into effective teams. J. Student Centered Learn. **2**(1), 9–34 (2004)
12. Lou, Y., MacGregor, K., Enhancing project-based learning through online between-group communication. Educ. Res. Eval. **10**, 419–440 (2004)
13. Sull, E.C.: Keeping teamwork alive, motivated, and enthused! In: Student Collaboration in the Classroom (2015)

Transferring Tacit Knowledge in Process Control

Anna-Lisa Osvalder and Anders Colmsjö

Abstract Experienced operators, who have worked in process industry for many years possess extensive tacit knowledge regarding how to operate and control the plant. The purpose of this study was to propose methods for knowledge transfer regarding process control. Four conditions are important for successful knowledge transfer: resources from the management, access to a control room environment, access to saved process data from incidents and disturbances, and motivated experienced operators with verbal skills. Methods recommended for catching tacit knowledge regarding process control are observations in the control room, operators using the think-aloud methodology during work, and expert operators creating and analyzing scenarios of disturbances. Methods for transfer tacit knowledge are scenario analysis of disturbances in focus groups, or role-play between experienced and novice operator. Also informal and spontaneous methods for knowledge transfer can be successful.

Keywords Tacit knowledge · Process control · Operator control · Expert · Methods

1 Introduction

To perform well an organization is dependent on the employees' competence. In an organization exposed to competition, knowledge is further a critical asset [1]. Studies have shown that a lot of explicit and implicit knowledge in an organization is hidden and synthesized among employees [2, 3]. Employees move over time in and out of the organization due to termination of the employment, new recruit-

A.-L. Osvalder (✉)
Division Design & Human Factors, Chalmers University of Technology, 412 96 Gothenburg, Sweden
e-mail: alos@chalmers.se

A. Colmsjö
Stockholm University, 106 91 Stockholm, Sweden

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ments, organizational change or retirements. Then, there is a large risk that important knowledge disappears when experienced people leave the organization [4].

People who have worked in an organization for many years possess extensive tacit knowledge regarding how to perform their working tasks. Tacit knowledge develops through practice over a long period of time. It is implicit in nature and not easy accessible for verbalization in speech or writing. It is often very difficult to describe orally how a complex working task should be performed without explicitly showing how to do it.

An important distinction is found between knowledge that an individual has difficulties to verbalise (tacit) or not want to verbalize (hidden). The fact that a person do not want to verbalize some knowledge could be that otherwise others can take over his/her working tasks, or if the knowledge becames public it could result in negative consequences for the individual or the organization.

Regarding studies of tacit knowledge, these have mainly been implemented in large information organizations such as IT-companies, banks, service companies and consulting firms. Here it is considered that knowledge sharing between employees is important for business success. Within these organizations informal methods are often used in order to transfer tacit knowledge [5]. Mentoring and apprenticeship, coaching, job rotation and personal networking are examples of situations where tacit knowledge can be transferred. However there are few organizations using formalized methods for knowledge transfer. It is also very seldom that evaluations are made if knowledge transfer has been accomplished in an organization or which effects it might have given.

Few studies are found regarding tacit knowledge in safety critical organizations such as process industry and control room operation. In process industry experienced operators and shift teams stand for vital knowledge about operation and control of the plant, both as explicit and implicit knowledge. Larsson et al. (2007) [6] discuss, related to the nuclear sector, the importance of preserve competence within the organisation by taking care of older employees competence when retired and when generational shifts occur. Engstrom (2014) [7] also shows for the nuclear sector, how operators' skills and experience can act as a safety method for process control, especially when handling unexpected events. Methods for knowledge transfer that are used today in process industry are internship and teamwork in shift teams [6]. Here, tacit knowledge of one person is transferred to tacit knowledge of others through socialization [8], which takes several years and the result is seldom documented.

One prerequisite for safety and efficiency in the process industry today and in the future is to increase the awareness of the older expert operators' unique tacit knowledge regarding how to control and operate the plant. The purpose of this project was to propose suitable methods for finding expert operators' tacit knowledge regarding process control and transfer this knowledge into the organization to be used for education and training of operators and new employees. The tacit knowledge should be associated with understanding, judgment and problem solving of critical operational situations. This knowledge deals with which

information, cues and patterns as well as which support systems that should be used to get a complete picture of the process status [9]. The project was conducted in collaboration with a process industry company responsible for operation and surveillance of the district heating system in a major city in Sweden.

2 Methods

As a basis for the proposals of methods for fining and transferring tacit knowledge regarding process control, literature studies were conducted. Furthermore interviews, observations, and questionnaires were performed within the process industry included in the project.

The literature studies dealt with definitions of tacit knowledge [10], and how this knowledge is stored in our memory [11]. Moreover knowledge conversion [8] has been studied as well as prerequisites and methods for knowledge transfer in various domains. Furthermore, the literature studies have considered characteristics for process control [12] and common working tasks performed in the control room environment, as well as the demands on operators, especially during unexpected events. Situational awareness, mental models and automation have also been studied related to process control.

In-depth interviews were performed occasionally during 1 year, with three skillful operational control engineers at the company. They had more than 15 years of experience of process control, control room work and how the various decision support systems function.

Observations were made in the control room on three occasions during 3 h each. Three different shift teams were then observed. Especially the type of information and which support systems that were used during work were studied, as well as how the team operators were communicating with each other.

Questionnaires were also distributed to all 42 operators in the six teams. The questionnaire dealt with what type of support they used for operation and control of the system, including everything from specific detailed information shown on screens to various type of help from colleagues. Also when and how often a specific support system was used were asked for.

3 Results

3.1 Conditions for Knowledge Transfer

From the literature studies together with all study visits at the process control company, four conditions were found to be desirable for successful transfer of tacit knowledge regarding process control within a process industry organization.

The four conditions were: interest and resources from the management of the organization, possibility to perform knowledge transfer in the control room environment (or in a simulator), access to saved process data from disturbances and incidents, and motivated experienced operators with verbal skills and interest in knowledge sharing.

3.2 Methods for Knowledge Transfer

The following methods were proposed to be used in a process industry company for knowledge transfer regarding process control.

1. Methods for mapping the situation of the actual control room system
2. Methods for finding tacit knowledge
3. Methods for transferring tacit knowledge

3.3 Methods for Mapping the Situation

The situation includes the following parts: working tasks performed in the control room, the control room operators' experience, information and support systems available, and documentation of previous incidents and disturbances.

To map the situation access is needed to a number of experienced operators and key people in the company who have a great knowledge of the process, have been active in the control room for a long period of time (at least 10 years, preferably up to 20–25 years) and have been involved in problem solving of a number of disturbances and incidents of different severity. Interviews, questionnaires and observations should be used as data collection methods to map the situation.

3.4 Methods for Finding Tacit Knowledge

Methods to find the tacit knowledge of experienced process operators deal with trying to find and understand the heuristics and rules of thumb they use to solve complex upcoming situations. Three useful methods to catch tacit knowledge regarding process control are observations of individual operator as well as team performance in the control room, asking operators to use the think-aloud methodology during work, and requesting expert operators to carry out scenario analysis of process disturbances.

3.5 Methods for Transferring Tacit Knowledge

Transferring tacit knowledge from experienced process operators to other operators deals with presenting information about the cues and patterns they use when they try to understand and solve problems during disturbances. Also of great interest is how they use different types of feedback from the system to judge how they should proceed the problem solving process. Furthermore, the expert operators' mental models of how the system is structured and functions are important to catch.

A useful method for transferring tacit knowledge regarding process control is scenario analysis of disturbances either in focus groups or as role-play between tutor and adept, i.e. the experienced operator teach an inexperienced operator.

Two useful methods for documentation of the tacit knowledge are checklists showing step by step how to perform a specific task, and compilation of heuristics and problem-solving strategies. Also development of a searchable incident report system including proposal for successful solutions is fruitful.

Informal methods for knowledge transfer can also be successful, such as net working, coffee break discussions and social activities. Tacit knowledge is then transferred to tacit knowledge through socialization, but the knowledge is not documented and available for all employees. These methods do not require much preparation or extra resources from the organization, but the frequency and content of the knowledge transfer is hard to catch and the effect on learning is not easy to measure.

4 Discussion

The result showed that the operators at the process industry included in the study had extensive tacit knowledge regarding how the process functions and how it should be operated and controlled during all types of operational cases. Their knowledge is not expressed or documented, which should be done before the older experienced operators disappear from the organization through retirements. There is no documentation available of how to use and interpret the information and support systems in the control room during disturbances. Their knowledge need to be transferred to other operators in the organisation, e.g. by creating a digital library of information and solution strategies for different types of disturbances and incidents. This can then be used to teach operators how to build knowledge in a faster way than by apprenticeship, of how to operate the system in a safe way. The methods proposed in this paper for finding and transferring tacit knowledge can be fruitful within the company.

The results showed that observations are possible to perform in the actual control room, scenarios of incidents can be created, and role-play between experienced operator and novice operator can be performed. However, the conditions for doing this are not always the most favorable within the company. The possibilities for

individual expert operators to participate in such activities can be a problem when they are a part of a team with tight time schedules. Here the management needs to find resources to release time for them to participate in such activities and also being interested in developing a climate in the company where all employees see the benefits of knowledge transfer.

When performing observations in the control room during on-going operation, it is possible to identify what information and which support systems the operators use, and also to listen to how the team members discuss problem solving strategies during various events. However, it is rare that more serious disturbances arise during an observation period, therefore the observations mainly can focus on finding the tacit knowledge that is used in the daily routine work.

Transferring tacit knowledge to new employees in the control room environment means that you are staying in the right environment both during learning and training. As a novice you can then ask questions and forcing the experienced operator to explain the control actions performed. It is important that the operators who are mentors also have a developed verbal skills in addition to being an expert of the system. Informal social transfer, such as during coffee and lunch breaks, is also a source of learning as well as social events outside the company.

5 Conclusion

There are few organizations that have adopted knowledge transfer as part of their working process or using formal methods for transferring tacit knowledge.

In process industry tacit knowledge is often transferred to tacit knowledge through socialization by mentorship, team work and informal social activities. The knowledge is then not easy to document and transfer to all employees.

Four conditions are needed for transfer of tacit knowledge in an optimal way in a process industry company; interest and resources from the organization, possibilities to perform the work in a typical control room environment, access to saved process data from disturbances, and motivated experienced operators with verbal skills and interest in knowledge sharing.

For knowledge transfer regarding process control it is important to use methods that can capture the operators' mental model of the system and find the cues and patterns that they use to interpret the status of the process at various operating states and to predict the future.

The methods recommended for the process industry in terms of finding tacit knowledge are observations in the control room, using the think-aloud methodology during work in the control room, and expert operators creating and analysing scenarios of disturbances and incidents.

The recommended methods for transferring tacit knowledge within the process industry are mainly scenario analysis of disturbances in focus groups, or role-play

between experienced operator and novice operator. Also informal and spontaneous methods for knowledge transfer can be successful, such as net working, coffee break discussions and social activities. These methods do not require much preparation or resources from the organization.

References

1. Teece, D.J.: Capturing value from knowledge assets. Calif. Manag. Rev. **40**(3), 55–78 (1998)
2. Wah, L.: Making knowledge stick. Manag. Rev. pp. 24–29 (1999)
3. Lee, J.: Knowledge management: the intellectual revolution. IIE Solutions, 34–37 (2000)
4. Smith, E.A.: The role of tacit and explicit knowledge in the workplace. J. Knowl. Manag. **5**(4), 311–321 (2001)
5. Lave, J., Wenger, E.: Situated Learning. Legitimate Peripheral Participation. Cambridge University Press, Cambridge (1991)
6. Larsson, A., Ohlsson, K., Roos, A.: Kompetensöverföring på svenska kärnkraftverk i samband med pensionsavgångar (In Swedish). SKI Rapport 2007:27 (2006)
7. Engström, M.: Yrkeskunnande som säkerhetsmetod vid svåra driftsituationer (In Swedish): Doctoral dissertation. KTH Royal Institute of Technology, Stockholm (2014)
8. Nonaka, I., Takeuchi, H.: The Knowledge Creating Company: How Japanese Companies Create the Dynamics of Innovation. Oxford Press, London (1995)
9. Klein G.: Applied Cognitive Task Analysis Job Aid. Klein Associates Inc, Fairborn
10. Baumard, P.: Tacit Knowledge in Organizations. Sage, London & Thousand Oaks (1999)
11. Badeley, A.D.: Working Memory. U.K. Clarendon, Oxford (1996)
12. Tschirner S.: The GMOC Model: Supporting Development of Systems for Human Control. Digital Comprehensive Summaries of Uppsala Dissertations from the Faculty of Science and Technology, ISSN 1651-6214; 1237 (2015)

Approachability as a Prerequisite of Student Reflection

Rosa Karnita, Andrée Woodcock, Simon Bell and Kollette Super

Abstract Research to encourage Indonesian undergraduate student engagement in graphic design courses is examined using the Hexagon Spindle (H-S) Model of Educational Ergonomics. The context of the study is the problems faced by first year Indonesian undergraduate graphic design students who struggle to become independent learners and engage in their studies. Two approaches were used to address this challenge, firstly to encourage increased student reflection by manipulating teaching methods (modelled on UK best practice) and secondly to encourage tutors to become more approachable, thereby creating a safer learning environment. In terms of the H-S model, the research highlighted personal, social and cultural issues and the importance of student–tutor interaction in creating an environment conducive to independent learning and reflection.

Keywords Educational ergonomics · Graphic design · Indonesia

1 Introduction

The study arose out of a need to address the perceived lack of student engagement and increased class sizes in an Indonesian undergraduate graphic design course. Increased class sizes mean that on the one hand students may not receive the personal levels attention they need from tutors and on the other hand that tutors may be overwhelmed by student numbers and unable to adjust their work practices to

R. Karnita (✉) · A. Woodcock · S. Bell · K. Super
Faculty of Arts and Humanities, Coventry University, Coventry, UK
e-mail: karnitar@uni.coventry.ac.uk

A. Woodcock
e-mail: A.Woodcock@coventry.ac.uk

S. Bell
e-mail: S.Bell@coventry.ac.uk

K. Super
e-mail: K.Super@coventry.ac.uk

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meet with the added demands on their time. Additionally students enrolled on Indonesian graphic design courses straight from school may have had little exposure to art and design or the skills necessary to become independent learners. Of especial interest in this study is their lack of exposure to reflective practice.

Until recently nonwestern education has been dominated by (Confucian) teacher led approaches, with teachers viewed as experts, to be copied and not questioned, rather than more Socratic approaches which challenge learners to develop their critical thinking skills and engage in analytic discussion [1]. The student is the listener, or receiver of information, silent except when answering questions. Where questioning does occur, it is not for the promotion of dialogue and reflection. The teacher's role 'is to effectively transmit facts or processes, explain the what, why and where of the subject matter, and present new knowledge' [2].

This may lead to students who are unable to think creatively or independently, and who may be fearful of approaching their tutors when they do not understand something, thence they may fall behind and become disengaged. In recognizing these problems, Indonesia is emphasizing the need for more student centred approaches to learning. This is problematic in so far as tutors may not have experienced Socratic teaching as students themselves, and as such may be unsure of what strategies to adopt.

The Hexagon Spindle Model of Educational Ergonomics [3, 4] provides a means of approaching student centred learning (see Fig. 1). It acknowledges (through the spindle) that learning can be achieved in many ways (not just in the classroom) and that each learning experience, for each learner, may be influenced by different factors. The 'hexagon' is a development of the concentric rings models [5], with the user (in this the case the learner) being placed at the centre of the hexagon. Learning interactions can be influenced by the immediate workstation (e.g. design of teaching materials, interfaces and tools), work place (e.g. classroom layout), work setting (e.g. management the university) and external factors (such as governmental issues, climate. A segmented hexagon, rather than a circle is used to represent organizational (management and infrastructure), design (product and task) and personal (social and personal) sectors which can influence any of the layers. The goal of student centred learning is to optimize each of the elements for each student in each environment where learning takes place. The model has been previously used to consider lap top usage [3] and the design of polysensory environments for children with autism [4].

The aim of this study was to find ways in which student engagement could be increased through encouraging reflection [6] and increasing the approachability [7] of the tutors. In order to achieve this, a series of investigations and implementations were made and triangulated the lecturers' perceptions of their teaching, students' perceptions of their learning, and (participant) observers' perspectives on teaching and learning. The work took place in a cross cultural context, with comparisons made between UK and Indonesian graphic design courses [8].

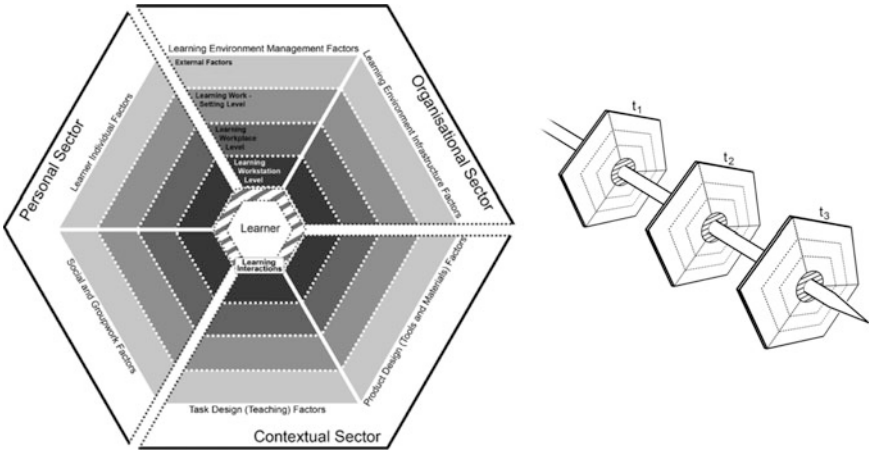


Fig. 1 Components of the hexagon spindle model

2 Comparison of the Experience of Students in the UK and Indonesia

Using pedagogic practices employed in a UK university as a contrast to teaching and learning in Indonesia an observational study (of a sample of lectures, tutorials, critiques, studio practice and visits) was conducted of undergraduate graphic design teaching. This was augmented by semi-structured interviews with tutors at both institutes, focus groups with students and the use of the STERLing questionnaire [9] to provide a rich picture of the student learning experience, with especial emphasis on the role of the tutor in providing a safe learning environment.

Triangulation of the studies revealed a consistent picture; in the UK reflection is valued by both students and tutors and is facilitated through self-assessment and peer reviews, both the focus groups and interviews confirmed that reflective thinking was not widely understood or applied in Indonesia. The scores relating to small group teaching as measured by the STERLING questionnaire were lower from the Indonesian sample pointing to dissatisfaction with the learning environment, management and approachability of tutors.

The study highlighted that part of the lack of engagement of the Indonesian students might be due to issues around tutor behavior (i.e. lack of approachability), management of learning (e.g. discipline, instructional methods) and the students lack of confidence and knowledge of reflection. The results were used to inform the design of an implementation study which aimed to replicate some of the UK experiences.

3 Experiences with Transferring Best Practice Teaching and Learning Methods to Indonesia

An intervention was designed to understand how teaching methods influence the perceptions, feelings, and learning of students and to assess the extent to which reflection contributes to learning outcomes. Given that the teachers and students had little experience of Socratic education, the attempt to implement new teaching and learning methods into one module for a term might have been overly ambitious. It certainly did not go according to plan [9]!

Using the one-semester module in Visual Literacy as a vehicle for experimentation, 132 first-year Indonesian undergraduate Graphic Design students in three classes, and their 9 tutors enrolled in the study. They were randomly allocated into three classes A, B, and C (44 students for each class). Each class met 2 times a week. Only those who achieved a minimum of 80 % attendance were considered as engaging in the course, and were included in the analysis. All students followed the same course and learning assessments (i.e. to provide visual solutions to 5 design briefs of varying complexity). The students met twice a week with their tutors and peers. After training with staff and students, the following intervention plan was designed,

- Class A—high level of intervention through learning activities with small group discussion, seminars, peer review, small group tutorials, one to one tutorials, and keeping a sketchbook and reflective writing.
- Class B—moderate intervention through small group discussions, one to one tutorial, and keeping a sketchbook and reflective writing.
- Class C—control group, who were taught in the normal way, with one to one tutorials and keeping a sketchbook.

After the 2nd brief tutors deviated from the experimental protocol (see Fig. 2) which meant that no reliable quantitative comparisons could be made between the 3 conditions. The tutors in Class A used small groups and every meeting in the studio became a peer review. In effect, this reliance on peer learning, reduced rather than increased their approachability. In Class B, the tutor adopted small group teaching, and remained available for one-to-one tutorials if needed. The tutor in Class C (the control group) was able to observe what was happening in Class B as they shared a

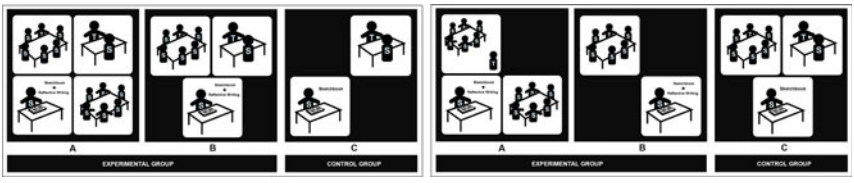


Fig. 2 Intervention as planned and as it evolved

studio, and copied the intervention method whilst retaining the one-to-one tutorials. Interviews with tutors revealed that the high intervention condition was considered too extreme with both tutors and students felt overburdened. In the moderate intervention condition the tutor felt that the students were comfortable working in groups, and did not want to come for one-to-one tutorials. The tutors in Class C, using traditional teaching methods felt exhausted by the one-to-one tutorials because of the large class size, so they imitated the small group teaching and other innovations.

The observational studies, interviews with the tutors, focus groups with the students, and students' sketching journal were analyzed to show that students and tutors did derive some value from the interventions. The tutors engaged on an action learning and reflective cycle to tailor the new teaching methods to better meet the classroom context. As experts, the tutors know what their students can tolerate and what teaching methods they (both staff and students) feel most comfortable with. Therefore, they only applied those teaching methods which would progress the students.

Despite their failure to follow the intervention plan, the tutors engaged on an action research cycle where they planned, observed, reflected, and developed new strategies (based on the training they had recovered in the initial workshops) to improve their teaching practice and student learning. The tutors were more satisfied and felt more rewarded when they engaged with students in the learning process, and they noted a difference between their current practice and the activities they engaged in the intervention. For example, the tutor in Class B understood her role as a facilitator, and the tutor in Class A acted as a moderator. In both cases this allowed them to connect the students who need specific technical skills with their peers or seniors to teach themselves. The tutor in Class C was curious to discover whether small group teaching would alleviate the problems associated with a high number of one-to-one tutorials. He found that teaching in this way (small groups) made him more approachable.

The qualitative data analysis revealed that the design of teaching and choice of learning activities can influence reflective learning but cultural issues need to be considered. Some of these issues are reflected in the Fig. 3 in the personal sector of the model. Students were interested in breaking down the barriers with their tutors and getting more feedback on their work. However, they lacked the confidence and experience to do this. The most successful of the interventions was group learning where the tutor remained a member of group, creating a safe space for learning and reflection, and becoming most approachable.

Although students are asked to produce a quantity of sketches to complete their design briefs, these are not used for formative assessment. Sketching is an activity students enjoy and the sketches could provide an opportunity to engage in dialogue with peers and tutors. Analysis revealed that the reflection found in most journals was still at the level of description, rather than reflection on ideas and design ability, students readily understood the value of using these.

The intervention revealed several areas which need addressing if students are to become confident, independent designers, in particular issues found in the personal sector of the model which relate to external (cultural issues), such as pedagogic

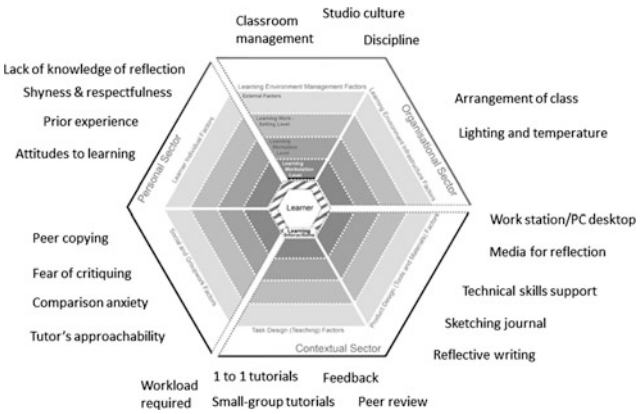


Fig. 3 Factors influencing the outcome of the intervention study related to the H-S model

practices and traditions, beyond the remit of this research. One area which strongly emerged was the relationship between tutors and students and the influence this has on developing a safe environment for the exchange and growth of ideas.

The focus of the H-S model has been on the learner, the corollary of this is the tutor. The working environment should support teaching staff. It should provide structures for growth and experimentation and enable staff to not only work effectively and efficiently, but with pride and satisfaction. Simply increasing student numbers, without increasing staff, or providing them with training and resources to cope with increased numbers will lead to dissatisfaction and stress in both staff and students. In the Indonesian university there was some evidence that the lack of support for staff and the burdens placed on them (e.g. increased numbers, design of course work, class sizes) had a detrimental effect on tutor–student relationships. It may be argued that this relationship is critical in design related disciplines, which seek to develop creativity, independence of thought and designers who are capable of leading and defending their design ideas.

4 Developing the Approachability of Tutors

Teaching needs to be underpinned by strong relationships between staff and students. This is an area which has not received too much attention in educational ergonomics which has focused more on the design of the physical environment. Indonesian tutors did not appreciate the importance of, or were not willing to create a safe and supportive atmosphere for their students. As such some students remained un-motivated to improve their work and the learning atmosphere tutors provided in the studio that was not comfortable inhibited student reflection. Therefore, it led to a hypothesis that approachability is seen as a key requisite for

promoting reflection in teaching and learning in Indonesia and ways need to be found of encouraging tutors to become more approachable. Without this safe space, students may feel unable to present their work in its fullest and will feel unable to disclose their ideas. Any feedback provided by tutors or peers may be seen as hostile resulting in defensive attitudes by the students, who may not reflect on recommendations.

In the first stage of the investigation a card sorting task was used to understand the attributes students associated with tutor approachability. From this an online survey was produced and completed by 172 Indonesian students and 29 tutors. The analysis revealed 8 categories (shown in Table 1).

The second part of the study involved an intervention with 6 Indonesian graphic design tutors based on Action Learning Sets. In brief the tutors were presented with feedback regarding their approachability from their students, and were asked to

Table 1 Attributes of tutor approachability

Category	Attributes
Open minded	Listens to students' viewpoints and ideas—respects students' opinions—receive constructive criticism without taking it personally—maintain openness, even when the topics are challenging—values students' contributions
Engaging	Interact easily and meaningfully with students—stimulates and welcomes students who are not involved in a discussion—inspires students rather than impresses them—encourages examples drawn from personal experience—remembers students' names
Communicative	Gives clear guidance when asked for help—gives constructive criticism without sounding harsh—breaks uncomfortable silences—when questioned, provide a sympathetic context for intellectual debate—uses adequate pauses during conversation, instead of talking for the sake of talking
Positive body language	Makes eye contact when talking to students—show positive gestures when talking to students—gives a 'thumbs up' or encouraging nonverbal gestures, to show compliments and praise—ensures a comfortable physical distance with students during discussion—keep arms uncrossed during discussion
Reachable	Responds to students' messages or queries—provides a flexible time to address any urgent situation—offers various methods of contact (email, phone, fax, in-person, etc.)—is accessible outside of group situations for students who are shy in front of others—maintains a simple, easy-to-type, easy-to-remember email
Professional	Maintains professional relationships with students—creates a safe climate for all students to participate in discussions—allows adequate time for discussion—is assertive to maintain discipline
Authentic	Is enthusiastic about learning—being themselves in their words and actions—is confident enough to be humble—is known by many students in all year groups
Kind hearted	Encourages students instead of intimidating them—maintain a friendly demeanour to students—empathic to the problems faced by students – smiles and greets students

discuss this with other tutors in the ALSs and develop strategies they could implement in the classroom to reduce their perceived unapproachability. In the last set ALS, each participant presented their experiences during the intervention, how they overcame obstacles and whether their efforts stimulated students' reflection.

In order to determine whether changes had been made to teaching styles, each ALS was recorded, and unobtrusive classroom observations were made in the classroom; interviews or focus groups were held with the tutors and representative students; students also rated the approachability of their tutors before and after the intervention and created metaphoric sketches [10] to illustrate qualities of their tutors (Fig. 4 shows an example). The tutors worked on various issues, such as their ways of asserting discipline, eye contact, use of demonstrations, less formal dialogue. The effects on the students of the changes made can be seen in the following quotes.

To summarize, this final study dealt with issues relating to student's lack of engagement by encouraging tutors to be more approachable and create an environment conducive to learning. Comments from the interviews with students after the invention included

> I absolutely agree that if a tutor is approachable, it does make difference and influences my progress for better than before because I feel safe and I am sure that he can be my guide to keep me on the track. (Interview: Student 5)

> It does not matter if a tutor gave us many works to do, but they also need to measure our capacity and the most important is to keep being friendly with us, at least, even though we have many things to do, their friendliness will keep me motivated. (Interview: Student 10)

In contrast to the first study, we did not implement best practice from another culture, but, having noticed tutors enthusiasm for making changes to their practice with a little guidance, used ALSs as a space in which tutors could share ideas, experiences and strategies, and reflect on their own practice. This approach worked well, provided tutors with support and enabled them to reflect on the changes they had implemented. Although it was not possible to quantitatively measure changes in reflection or learning outcomes based on the intervention, the feedback from the students to the changes made was positive.

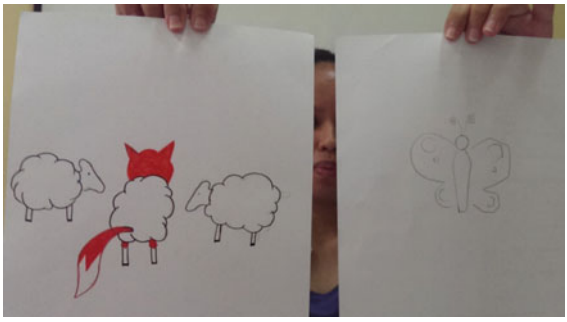


Fig. 4 Example of a metaphoric sketch of a tutor (before and after intervention)

5 Conclusions

The research has identified some shortcomings in the Indonesian approach to teaching and their implications in terms of the effectiveness of teaching and student satisfaction. Many universities are faced with similar problems and a need to consider the wider context and cultural factors when moving to more student centred approaches to teaching, fostering reflection has been identified. Tutor approachability was identified as a key component in supporting reflective practice, its components prioritised for Indonesia (these may be different for other cultures) and a transferable action learning process developed which led to tutors developing their own strategies/styles of engaging with students.

The H-S model has been used to provide a more holistic approach to the design of the learning and teaching environment, identifying changes which need to be made from national through to workstation level, bearing in mind the government's policy to create more student centred approaches to teaching, whilst having to deal with greater student numbers. In summary, the application of the Hexagon-Spindle model to the problem of increasing student engagement through the encouragement of reflection and staff approachability led to the following insights (Table 2).

The H-S model clearly identifies the 'wicked' nature of problems associated with implementing even small changes to higher, even with the buy in of all stakeholder groups (in this case the university, tutors and students). Reflection may contribute to the development of independent learners, but this needs to be built up gradually—perhaps from primary school level. Tutor approachability and ability to classroom

Table 2 Summary of influencing factors against levels in the H-S model

The external environment level	Governmental push for student centred learning, need for effective commercial graphic designers, increased number of students entering higher education, Confucian teaching traditions
The learning work setting level	Opportunities for CPD, management and design of facilities and timetable, teaching culture, academic requirements, design of curriculum, ease with which changes in organisation of teaching can be accommodated
The learning work place level	Tutor–student relationship, role of tutor (actual and perceived), classroom/studio organisation and culture, active and student led learning, teaching styles, organisation of tasks, discipline
The learning work station level	Provision and use of resources to support learning and co-learning, allocation of staff
The learner interaction level	Way in which tutors and students are able to interact with and use resources effectively to create opportunities for independent thought, creativity and reflection. The approachability of the tutor and the extent to which a 'safe environment' has been created in which to share and express ideas
The learner	Attitudes to learning, motivation, levels of interest, readiness to become an independent learner, maturity, previous experience, cultural traits, extent to which individual needs can be accommodated within the leaner interaction level

cultures in which students feel confident to express themselves is important, and the effects of tutor behaviour on student learning have not been fully explored in the H-S model. In terms of implementation, the transference of best practices from one culture to another is not always the best approach, rather tutors should be supported in developing their own practices.

References

1. Tweed, R.G., Lehman, D.R.: Learning considered within a cultural context. Am. Psych. **57**(2), 89–99 (2002)
2. Wang, H.: The influence of the socratic tradition on cambridge practice and its implication on Chinese higher education. J. Cambridge Stud. **5**, 1 (2010)
3. Benedyk, R., Woodcock, A., Harder, A.: The hexagon-spindle model for educational ergonomics. Work J. **32**, 237–248 (2009)
4. Woodcock, A., Benedyk, R., Woolner, A.: Applying the hexagon-spindle model for educational ergonomics to the design of school environments for children with autistic spectrum disorders. Work J. **32**, 249–259 (2009)
5. Galer, I. (ed.): Applied Ergonomics Handbook. Butterworths Scientific, Guildford (1987)
6. Schon, D.A.: Educating the Reflective Practitioner: How Professionals Think in Action. Arena, Aldershot (1987)
7. Bedner, N.: Coming down from the Academic Pedestal: A Phenomenological Investigation of Instructor Approachability. Ph.D. thesis. Ohio University, Ohio (2000)
8. Karnita, R., Woodcock, A. and Super, K.: A Matter of Questioning: A Comparative Study of Reflective Practice in Graphic Design Courses in the United Kingdom and Indonesia, 7th INTED Conference, pp. 1805–1812 (2013)
9. Schaub-de Jong, M.A., Schonrock-Adema, J., Dekker, H., Verkerk, M., Cohen-Schotanus, J.: Development of a student rating scale to evaluate teachers' competencies for facilitating reflective learning. Med. Educ. **45**(2), 155–165 (2011)
10. Polanyi, M.: Personal Knowledge: Towards a Post-critical Philosophy. Routledge, London (1958)

The Creativity in a Virtual World: A Pilot Study

Siao-Wei Huang and Yu-Chen Hsu

Abstract In recent years, there has been growing interest in the study of creativity and there is a great deal of general literature on cognition. Researchers of creativity have often suggest that manipulate nonconscious cognition with "priming". Researchers of improving creativity have often suggest that it conduct to study behavior of individuals or team work in a virtual setting. This paper will examine that the creative priming environment developed by Bhagwatwar et al. [1] can provide a framework for creativity. To conclude, this study may be of importance in explaining the relationship between creativity and virtual world, as well as providing system designer with a better understanding of how user's cognition about creativity relate to their strategy use.

Keywords Creativity · Virtual world · Priming effect

1 Introduction

In recent years, various ways of Information and Communication Technologies (ICTs) such as video conference, teleconference, and Second Life have gradually come into the convenient sphere of team creative collaboration and productivity where people develop their virtual avatars and immersive in a special screen. There has been an increasing interest in the interaction of human behaviors and virtual world (see for example Bhagwatwar et al. [1]; Dennis et al. [2]), especially, the human behavior about to attempt to change or evoke someone's internal

S.-W. Huang (✉)
Institute of Information Systems and Applications, National Tsing Hua University, No. 101, Guangfu Rd., 30013 Hsinchu, Taiwan
e-mail: s101065805@m101.nthu.edu.tw

Y.-C. Hsu
Institute of Learning Sciences, National Tsing Hua University, No. 101, Guangfu Rd., 30013 Hsinchu, Taiwan
e-mail: ychsu@mx.nthu.edu.tw

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representations of concepts, attitudes, intention, cognition, or beliefs, and even induce someone's external expressions of verbal or physical.

Nowadays, Egan points out that creativity seems an essential indicator of countries, organizations, and people [3]. While all seem to agree that creativity cannot be entirely separate from virtual world forces, opinions differ as to how improvement creativity should relate to the virtual world of creative thinking. Some scholars have argued that leadership style play an important role in creative invention, for instance, Surinder et al. (2003) hold that transactional leadership led to more group efficacy and original solution relative to transformational leadership [4]. Zhong et al. advocate applying creative thinking skills through manipulating conscious cognation might interrupt the search for creative answers and retrain creative thinking [5]. In Slepian et al. (2010) exposing participants to achieved an insight, and enhanced insight problem-solving with illuminating lightbulb primed concepts [6]. Leung et al. (2012) have discussed that embodied metaphors for creativity could enhance creative problem solving [7].

Hence, according to Montoya et al. believe that owing to new technological advances and globalization, distributed virtual teams have gained popularity in organizations in the future [8]. For example, in 2009 Cisco pointed out 83 % of respondents said telecommunication with co-workers is better than in office, and 67 % of respondents said they have higher quality of their work [9]. The present author also contends that the virtual world tends to a well environment and could increase the creativity.

2 Literature Reviews

2.1 Creativity

Fifty years ago, educational theorists and researchers were investigation the concept of creativity: how the creativity actually functions, how it process information or is affected by each individual's perceptions. Sternberg and Lubart (1999) defined creativity is the ability to develop original and appropriate ideas [10]. Various groups of researchers have worked with characteristics of the creative process; each group has its own taxonomy. For example, Eyesenck have written widely about the relationship between creativity and personality, and the creativity is considered knowledge activation [11]. Mednick put forward a model in which he have discussed the relationship of associative behavior and creativity [12]. Guilford has proposed the terms "Divergent thinking"—creativity is deliberated as a thought process used to generate more creative ideas by exploring many possible solutions [13]. Baker-Sennett and Stephen have do extensive work with his categories of creativity, which examine the relationship between problem solving strategies

(leaping and flexibility) and measures of insight, and finding the creative thinking include leap [14]. As a general rule, creativity probably ranges between two types of concept: environments where provide priming stimulus or atmosphere to people make creative thinking, and individual difference which influence the ability of creative thinking.

In previous research has focused on the cognitive process of creativity and how to improve creative skill. Nowadays, producing creativity with team in virtual world is very essential. For instance, Alahuhta et al. reveal eight affordances for virtual worlds to raise team level creativity, such as avatars, changing the frame of reference, co-presence, immersion, multimodality, rich visual information, simulation capabilities, and supporting tools. Each affordance has enough literatures to support for virtual world can improve the potential ability of participant to creativity [15]. Other researchers, however, Surinder et al. (2003) suggest that anonymity in virtual world let to free rider problem, it means bring lower participation and cooperation in the group rewards condition versus the individual rewards condition [4]. Recently, Barrett et al. focus on the relationship between creativity and working memory capability (WMC) and this work found that WMC supports performance on complex cognition and academic actives, hence, producing creativity need higher WMC [16].

2.2 Priming Effect

Recently, human-computer interaction (HCI) field has suggest that priming effect could conduct to study behavior of individuals or team work in a virtual setting [17].

Bargh and Chartrand noted that priming usually influence subsequent behavior by an individual prior experiment, cognition, when objects are activating some mental imagery which could increasing comprehend and manipulate the content more accessible [18]. Several of way could activate internal concepts, such as picture, color, scrambled words, pictures, auditory signals, objects, or computer game. In 2013 an article was published by Bhagwatwar et al. that posit visual elements (i.e., plants, adequate illumination, and objects of various shapes, sizes, and colors) in 3-D Virtual Environments (VEs) to improve creativity as creative priming environment, (Fig. 1a) and only posit visual elements (plants) as natural priming environment (Fig. 1b), and examine the performance of team brainstorming. In order to examine the creativity, it adopts two tasks: increasing tourism and reducing pollution, the participants are informed to generate as many ideas as possible, in consequence participants in creativity primed environment generated more ideas and better quality than in neutral priming environment [1].

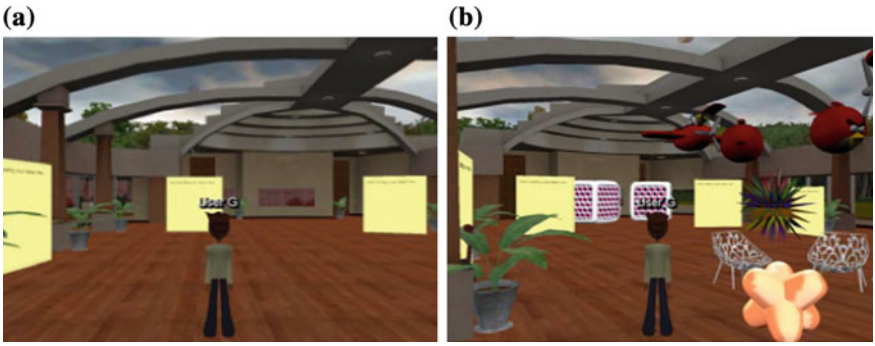


Fig. 1 **a** The neutral priming environment. **b** The creative priming environments [18]

2.3 Research Questions

In order to get a better understanding of how users be aware of stimulus which can be affected by priming, how they behave, and what can be done to improve creative thinking, this study focused on three main aspects. For each aspect, a separate research question was formulated:

- Define the creative priming objects design criteria
- Q1: Creative priming concerns in general: What do people activation prior knowledge?

Answering those question might give useful advice on how to improve creativity for users with appropriate stimulus in virtual world. This study hopes to gain a better understanding of the nature of the creative priming design and, most particularly, to be able to decide between the two versions of creativity above.

- Q2: Creative priming stimulus is appropriate in general: Does everyone could accept those information with priming?

Answering those question might give useful advice on how to improve creativity for different talent users. This study hopes to gain a better understanding of the environment setting of the creative priming object.

3 Methodology

This is a between subject experiment with two independent variables and several dependent variables explained below:

Independent variables: There are two independent variables (see Table 1). One is the creativity personality traits of users in terms of high-creativity user or

Table 1 Four groups in the experiment

	High-creativity user	Low-creativity user
High rich visual information	15 subjects/Group A	15 subjects/Group C
Low rich visual information	15 subjects/Group B	15 subjects/Group D

low-creativity user. The second is the degree of rich visual information of the environment (high and low). In order to identify subjects' creativity ability, they first filled in a questionnaire to identify their own remote association ability. Then the high-creativity and low-creativity subjects were randomly assigned to the high or low rich visual information group to perform creativity output, with each group containing 15 subjects.

Dependent variables: In order to measure subjects' creativity ability, there are some dependent variables including (1) Fluency—the number of ideas produced, (2) Flexibility—the number of different categories of ideas, and (3) Originality—the number of original ideas generated. This study adapts (Almeida et al. 2008) states the Torrance Tests of Creative Thinking (TTCT) are one of the best measures of creativity [19].

3.1 Procedure

First, the participants were randomly assigned to the four group. The first stage of the experiment was the training session. Following the training, the participants were asked to complete the task which enquire participants' interact with virtual object. At the end of the experiment, the purpose of the experiment was explained and a NT$50 coupon was given as a token of gratitude.

4 Expected Findings

The purpose of this study was to explore how level of rich visual information in virtual environments for a creative industry is suitable. The researcher predict there are significant main effects of individual creativity—higher/lower creativity—and the level of rich visual information—higher/lower rich visual information of creative priming. The study also examines the relationship of the subset of creativity and two environments. The study expects find what environments fit individual creativity on virtual world. Right now the researchers are still collecting the data. The research results will be able to provide implications for visual information objects design in virtual worlds.

References

1. Bhagwatwar, A., Massey, A.K., Dennis, A.R.: Creative virtual environments: effect of supraliminal priming on team brainstorming. In: System Sciences (HICSS), 2013 46th Hawaii International Conference on IEEE (2013)
2. Dennis, A.R., Minas, R.K., Bhagwatwar, A.P.: Sparking creativity: improving electronic brainstorming with individual cognitive priming. J. Manag. Inf. Syst. **29**(4), 195–216 (2013)
3. Egan, T.M.: Creativity in the context of team diversity: team leader perspectives. Adv. Dev. Hum. Res. **7**(2), 207–225 (2005)
4. Kahai, S.S., Sosik, J.J., Avolio, B.J.: Effects of leadership style, anonymity, and rewards on creativity-relevant processes and outcomes in an electronic meeting system context. Leadersh. Q. **14**(4), 499–524 (2003)
5. Zhong, C.-B., Dijksterhuis, A.P., Galinsky, A.D.: The merits of unconscious thought in creativity. Psychol. Sci. **19**(9), 912–918 (2008)
6. Slepian, M.L., et al.: Shedding light on insight: priming bright ideas. J. Exp. Soc. Psychol. **46** (4), 696–700 (2010)
7. Leung, A.K.-Y. et al.: Embodied metaphors and creative "acts". Psychol. Sci. **23**(5), 502–509 (2012)
8. Montoya, M.M., Massey, A.P., Lockwood, N.S.: 3D collaborative virtual environments: exploring the link between collaborative behaviors and team performance. Decis. Sci. **42**(2), 451–476 (2011)
9. Schwartz, A.: Cisco Says Telecommuting Saves Money, And The World. Message posted to Ref-Links Electronic Mailing List. http://www.fastcompany.com/1300971/cisco-says-telecommuting-saves-money-and-world
10. Sternberg, R.J., Lubart, T.I.: The concept of creativity: prospects and paradigms. Handb. creativity **1**, 3–15 (1999)
11. Eysenck, H.J.: Genius: The Natural History of Creativity. Cambridge University Press, New York. NY (1995)
12. Mednick, S.A.: The associative basis of the creative process. Psychol. Rev. **69**, 220–232 (1962)
13. Guilford, J.P.: Creative abilities in the arts. Psychol. Rev. **64**, 110–118 (1957)
14. Baker-Sennett, J., Stephen, J.C.: Clue-efficiency and insight: unveiling the mystery of inductive leaps. J. Creative Behav. **30**(3), 153–172 (1996)
15. Alahuhta, P., et al.: Fostering team creativity in virtual worlds. J. Virtual Worlds Res. **7**(3) (2014)
16. Barrett, L.F., Tugade, M.M., Engle, R.W.: Individual differences in working memory capacity and dual-process theories of the mind. Psychol. Bull. **130**(4), 553 (2004)
17. Chalfoun, P., Claude F.: Showing the positive influence of subliminal cues on learner's performance and intuition: an ERP study. In: Intelligent Tutoring Systems. Springer Berlin Heidelberg (2010)
18. Bargh, J.A., Chartrand, T.L.: Studying the mind in the middle: A practical guide to priming andautomaticity research. In: Reis, H., Judd, C. (eds.) Handbook of Research Methods in Social Psychology (in press)
19. Almeida, L.S. et al.: Torrance test of creative thinking: the question of its construct validity. Thinking Skills Creativity **3**(1), 53–58 (2008)

Nurses Students' Perception About Learning Online Using Social Networks

A.S. Campos Filho, L.D. Castro, R.J.S. Moraes and A.S. Gomes

Abstract Education is a complex process and the incorporation of technology into health education continues to be a growing trend worldwide. This trend can be attributed to Internet proliferation and the emergence of social networks. Furthermore, there are few graduate programs in nursing that use social networks to support to teaching-learning. This study aims to analyze the students perception about learning and usability in the use of social networks during the teaching-learning process. For conducting the study we performed a case study with the participation of 180 students. An evaluation was done through a learning and usability questionnaire applied to students. The results of the study showed that 95.5 % of students used the social network in the teaching learning process. These students reported that the interaction with the social network was simple and useful. We conclude that the use of social networks in pedagogical practice is important for learning and exchange of information.

Keywords Usability · Social network · Nursing · Learning

A.S. Campos Filho (✉)
Telehealth Center of Clinical Hospital, Federal University of Pernambuco, Recife, Brazil
e-mail: amadeu.campos@nutes.ufpe.br

A.S. Campos Filho · L.D. Castro · R.J.S. Moraes
São Miguel College, Recife, Pernambuco, Brazil
e-mail: lisdantas13@gmail.com

R.J.S. Moraes
e-mail: rubimorais16@gmail.com

A.S. Gomes
Computer Science, Federal University of Pernambuco, Recife, Brazil
e-mail: asg@cin.ufpe.br

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1 Introduction

Education articulates the processes of teaching and learning, understanding and adaptation. It is a fact observed in any society and is responsible for its maintenance and propagation from the transport to the generations that follow the cultural ways of being, living and acting needed to the communication and adjustment of a member in the group or society. In education, the flexible behavior is both demanded of teachers as a skill to be acquired, to students, future workers.

On the other hand, health education is a broad set of concepts and strategies, which before was the means of promoting health and treating disease, but today we know that is a set of actions that help the individual not only prevent disease but helps you make have a healthy lifestyle.

Education, especially the demands of health education, has been reappointed to broaden its margin of range in the services. You can set it with a discipline that provides a practical field and take place at the level of social relations, usually structured by health professionals, among themselves, with the institutions and the its users in the development of their daily activities.

It is important to observe the issue of education in nursing, because the professionals when acting in nursing practice will need theses knowledge. The nurses in their different ways of working will deal with these educational issues in health, it requires pedagogical framework that will help them as a qualified professional. Thus, the nurse needs to be instructed on health education in their graduation, since they will need when guiding a patient, and the family at the time of reception, or even when addressing the nursing staff among others moments.

However, health professionals are responsible not only to receive information about prevention of diseases, but also to promote learning about health education appropriately, within their competence as a professional, in their performance to take care of. However there are also some difficulties that are faced in relation to promoting the education as, for example, instructors without qualification, non-attractive educational methodology, and the lack of linking between theory and practice, not to democratize education among others.

1.1 Education and Technology

Currently the technological tools have been part of everyday life of people, and with the students this is no different. This fact positively favors the performance of the teacher. The technology reaches society in very complex way, promoting significant changes in the activities performed by the people. In this context, the change of the paradigm of the use of Informatics in the Education, due to its growing popularity, breaks with the idea of information technology as an isolated science, reinforcing the tendency of interdisciplinary, encouraging more and more people to its use in various areas of knowledge. As a result, the panorama of

education is changing, the computer and the Internet emerged as a means to facilitate the understanding of scientific and technological fundamentals, and the internet has shown new forms of relationship between theory and practice [1].

With the development of technological resources, new methods of learning are emerging as a key means to aid and educational guidance. Thus the use of health information technology has increasingly gained their space and the use of technological resources in undergraduate nursing has become common for student learning. According to [2] technological support can allow the student to learn significantly since the interactions facilitate reflection and critical thinking in nursing education. Jonassen [3] also reported that the computer can stimulate the construction of knowledge, conversation, articulation, collaboration and reflection, which facilitate meaningful learning.

Furthermore the rise of new media was essential to reflect on the different renovation possibilities in education and how these media can be used in the act of teaching. Through these new technologies, many doubts may be decreased and consequently minimize the anxiety and the fear of making mistakes. However, the major concern of teachers was to assimilate new technologies in nursing education in a reflective manner, understanding the computer functions that can be used in teaching, research, assistance and nursing management, building a new conception of computer, compatible with the human dimension in professional practice. Furthermore, the term of nursing informatics concerns the use of information technology related to customer service, the administration of health care or nursing education.

1.2 Social Network and Education

Recently the social networks become part of the daily lives of students and this is an immutable reality. More than entertain; social networks can become valuable interaction tools to support the learning process, if well used. The use of social networks occurs from the interaction and communication between the participants of the network, which sets as a social construction [4].

The social networks try to integrate more and more the need for the use of technological tools in education. The teaching and learning process must also be adapted to this new reality and not only the physical space of the classroom, but also in the virtual space. The social networks can be used as collaborative and cooperative spaces for establishing better interpersonal relationships, which can be of great importance to the teaching learning process. On the other hand, critically rethink the way of teaching and learning in digital media is likely to improve communication between students and teachers and suggests that communication through social networks can become an important factor for successful learning.

The social networks is a place to share multimedia materials, videos, music, movies, articles complementing the content taught in the classroom and promoting meaningful discussions so that there is an exhibition of opinion and also observe the

critical sense of the student. Furthermore the extracurricular activities were easier to be solved in groups, aimed at participant interaction and the exchange of ideas in the elaborate activities outside of the classroom.

According to [5] Facebook can be used in academic environments to promote library of many content, such as: content repository, chats, postings, assessment, reading groups and group study. There are different kinds of users that access the Facebook and they have diversified objectives. Some only use to navigate in pages, others do not participate actively or just observe the information posted on the page, many use the various website applications and to participate to academic discussions related to classes.

The Facebook is still the most used social network for sharing of activities. On Facebook can be created interacting groups for studies, where there are the exchange of information with teachers and students. The Facebook has been a technological tool used with great efficiency into consideration that in their platform aggregates features that enable interactive actions on the web as: affiliate with groups, view photos, create documents with the participation of all in building a collective text, create events schedule of activities within and outside the platform, create polls as a resource for research, chat, and more.

1.3 The Perception of Social Network as a Educational Platform

There are currently many technological communication and information tools that support the teaching and learning process. According to [6] evaluate the opinions of students about these tools is important to continue improving the quality of learning. Fonseca et al. [6] assessed the satisfaction of using an educational game that makes use of virtual simulation to demonstrate the reality, in this case, clinical nursing practice against premature, assessment of the offered feedback, contribution to learning and motivational feature for the user learn by playing. The study noted that 57.1 % of students found the game easy to use, didactic, enjoyable, free access, autonomy of decision and allows learning.

Solares and Carvalho [7] studied the perception of high school students from a public school in the interior of Pernambuco, however, regarding the use of information and communication technologies in teaching and learning process. The research result showed that the use of educational software resources and computer lab as a place for teaching practice reached low frequency of use in 18.8 and 33.9 %, respectively. This result notoriously showed the difficulty in uniting technology with education. Another interesting result found was that 62 % of participants use the Internet to access social networks, 50 % use chat rooms for communication and information exchange, 48.3 % make downloads of any kind of material (music and/or video) 58.6 % research school subjects and 41.1 % seek to

improve the knowledge of the world. These results thus show the educational potential in social networks.

Other studies [8, 9] evaluated the use of social networks as a pedagogical tool to support Higher Education in Distance methodology and noted that communication is established in that environment, resulted in significant exchange of material, knowledge and answering questions about the content covered. Regarding the perception of the students of higher education on the use of social networks as a pedagogical tool, some research [10–12] observed that these new technologies permit the rapid transmission of information and could be used by teachers to post tips, curiosities videos, articles or other materials and ask questions about the discipline through a specific forum.

However [11, 12] noted that this tool is not designed for educational purposes and that the challenge for teachers is to establish educational practices that allow an adequate appropriation of digital media in the educational process favoring collaborative learning, interactive and contextualized to the interests of the group.

2 Method

This study was based on a qualitative and quantitative approach of analysis containing an exploratory and a statistical part. As the process was mixed, the nature of the variables was qualitatively and quantitatively. The qualitative variable used to capture students perception in the study was their interpretation about the studied object, that is, understanding how users perceive the object studied and what were your experiences about it, understand their actions, their environment and the context in which the object is inserted and give a description of the built social perception [13]. The quantitative variable was used to analyze opinions, reactions, attitudes and habits that were measured by users.

2.1 Participants

The population consisted of undergraduate students of nursing of the São Miguel College who agreed in participating. To determine the sample size, a pilot study was conducted with 180 students from 2 different semesters, chosen at random so that 90 students are part of two classes of the first semester (2014.1) and the 90 are part of more two different classes of the second semester (2014.2).

To minimize bias, the information contained in the terms of participation explained that participation would be voluntary and that the information reported there were confidential, and only stored by researchers. The anonymity of all participants was guaranteed.

2.2 Context

The participants were Students attending the discipline of information technology applied to health in the first period of the course. Throughout the semester the teacher used the social network Facebook to post all teaching material of the discipline, encourage the exchange of information on the subjects taught, ask questions and interact with students. At the end of the course, students were asked to answer a learning and usability questionnaire of Facebook usage as learning tool the nursing program. After the data collection, performed the data analysis based on quantitative and qualitative approaches.

2.3 Usability Assessment (Nurse Students' Perception Evaluation?)

The best way to determine the degree of user satisfaction is through the use of questionnaires, which can be used alone or together with other usability evaluation methods [14] the satisfaction questionnaires are developed from psychometric techniques and quantified reliability and validity, in order to minimize biases the interviewee. Thus, the instruments used in the pilot study were divided into 3 questionnaires: 1—demographic questionnaire (11 questions); 2—learning questionnaire (8 questions); 3—usability questionnaire (15 questions).

The usability questionnaire used was based on based on heuristics of Nielsen [15] and ergonomics principles of Bastien and Scalpin [16] (Table 1).

To minimize transcription errors and avoid failure of any response, all questionnaires were created digitally and are available online to be filled through google forms tool. First, the respondent would have to accept participation term in the case study. After this acceptance, students began to answer the questions, which were mandatory, thus avoiding not completing the questionnaire.

2.4 Data Analysis

The collected data were stored in Microsoft Excel tool®2010. For statistical calculation, we used the statistical software R in version 2.11. In the descriptive analysis, we studied the mean and standard deviation. The parametric tests were used (t-student test to check for equality of means).

The usability questions were based on the Likert scale with questions ranging from 1 (weakest score) to 5 (strongest points). The means were calculated for each question. By default, we adopted a confidence interval of 95 % and a significance

Table 1 Relationship between usability issues with ergonomic criteria

Question	Ergonomic criteria
I thought I would use the system often	User experiences
I found the Facebook unnecessarily complex	User experiences
I found the Facebook user-friendly	User experiences
I thought I would need the support of a technician to be able to use Facebook	Help
Facebook functions were well integrated	Consistency
I found the Facebook inconsistent	Consistency
I suppose most people learn to use this system quickly	Recognition instead of memory
I found the Facebook very complicated to use	User experiences
I felt very confident with Facebook	User experiences
I had to learn a lot of things before using Facebook	Recognition instead of memory
I felt comfortable with Facebook	Aesthetic and minimalist design
It was easy to find the information I needed	Aesthetic and minimalist design
I liked using the discipline group with Facebook	User experiences
The type of interaction with Facebook is pleasant	User Control
The organization of information in Facebook screen is clear	Informational density

level of 0.05. The main research question used as a basis of comparison for all analysis of the study was one of the questions in the questionnaire (As you consider the ease of use Facebook for learning?) where the interviewee would have to choose among the concepts (Terrible, bad, Neutral, Good and excellent).

3 Results

3.1 Participants Technology Skills

According to the parameters chosen for the calculation of sample size, the sample size was 180 participants of 2 different semesters; chosen at random so that 90 participants are students of two classes of the first semester (2014.1) and the others 90 are students of more two different classes of the second semester (2014.2). The average age of students was 29 years in both semesters. The average income of participants is 2.9 Brazilian minimum salaries for the first semester and 2.2 minimum salaries for the second semester. Most of them have more than one technological equipment. The most frequent equipment among users is the television and the less frequent is the Tablet. This result shows that the use of mobile devices is not common among participants by some reasons including the high price of mobile

equipment, low family income and the culture of the region in not using technological equipment among nursing professionals. It may also be noted that the average of computer per student is greater than 1 computer. On the other hand, we can see on the results of questionnaires that all students had access to internet and that this access is more by cable connection (90.5 %) than by 3G (73 %).

Among the many places that the students access the Web, home was the place that had the highest average score (94.5 %). This information demonstrates that all users had access somehow the Facebook. Other relevant aspect that we observed in the study was that students accessed the Internet by several purposes, among the most cited purposes we can highlight: study (93.5 %), research (90 %) and access e-mail (87 %). Furthermore, the average access time frequency for the students of the first half was 06 days and 06 h and for the second semester is 06 days and 10 h. Between the two samples, the students of the first semester (86.6 %) accessed less the Facebook as learning technological tool in the discipline than students of second semester (95.5 %).

3.2 Nurse Students' Perception About Learning

Each question of the learning questionnaire is related to a criterion. The Table 2 shows the results of the course learning analysis through the use of Facebook.

Table 2 Results of the learning questions

Learning questions	1 Semester		2 Semester		p-value
	Mean	S.D	Mean	S.D.	
1—How do you rate the way that Facebook uses groups to meet their learning needs?	3.22	0.65	3.16	0.65	0.48
2—How do you consider the ease of use Facebook for learning?	2.98	0.88	3.18	0.68	0.07
3—How were the skills and expertise of the teacher to development of the discipline on Facebook?	3.58	0.56	3.61	0.63	0.79
4—How were your skills of computer use before the beginning of discipline?	2.83	0.86	2.74	0.98	0.46
5—How was the communication developed between teacher and student during discipline on Facebook?	3.45	0.66	3.40	0.70	0.64
6—How was the didactic-pedagogical practice developed by the teacher in classroom moments?	3.60	0.58	3.47	0.67	0.15
7—How was the level of flexibility of your learning in relation to time and space on Facebook?	3.02	0.66	3.16	0.78	0.24
8—What was your assessment of learning developed in the discipline?	3.27	0.64	3.20	0.78	0.48

The Table 1 shows the average score of the answers of all the participants on each semester in relation to the level of learning in the discipline with the help of Facebook social network as education support tool. The score of answers to the questions were classified as follows: score to 0.9 (Terrible) between 1 and 1.9 (bad) 2 to 2.9 (Neutral) of 3 to 3.9 (Good) and equal to 4 (excellent). As seen in Table 1, all learning questions had the score more than 3.00 meaning that the students liked to use the Facebook as technological learning tool.

In relation to the question of the learning of the discipline with the use of Facebook (question 8) it is observed that the mean score of the two semesters were close with score of 3.27 to the students of the first semester and 3.20 for students in the second semester but do not have significant difference between them ($p = 0.48$, $p > 0.05$). Another relevant factor shown in Table 1 was the mean of all the questions answered by the students of both two semesters were similar and there was no significant difference between them ($p > 0.05$). The result of the survey responses regarding the usability of Facebook can be seen from Table 3.

Table 3 Results of the usability questions

Usability Questions	1 semester		2 semester		p-value
	Mean	S.D.	Mean	S.D.	
1—I thought I would use the system often.	2.80	0.79	2.70	0.89	0.33
2—I found the Facebook unnecessarily complex	1.06	0.88	0.76	0.72	0.01
3—I found the Facebook easy to use	3.25	0.74	3.16	0.78	0.44
4—I found necessary the support of technician to help me in the use of Facebook	0.87	0.97	0.57	0.75	0.04
5—The functions of the Facebook were well integrated	2.96	0.71	2.81	0.81	0.24
6—I found the Facebook inconsistent	1.29	0.86	0.83	0.78	0.2310–3
7—I suppose most people learn to use this system quickly	2.84	0.94	2.80	0.86	0.75
8—I found Facebook very complicated to use	0.79	0.97	0.67	0.87	0.37
9—I felt very confident with Facebook	2.78	0.99	2.83	0.82	0.61
10—I needed to learn a lot of things before you continue using Facebook	1.39	1.23	0.94	1.01	0.01
11—I felt comfortable with Facebook	2.91	0.77	3.02	0.90	0.39
12—It was easy to find the information I needed	2.98	0.77	3.04	0.78	0.56
13—I liked using the discipline of the group on Facebook	3.20	0.79	3.13	0.80	0.48
14—The type of interaction with Facebook is pleasant	3.14	0.76	3.01	0.83	0.20
15—The organization of information in Facebook screen is clear	2.96	0.95	3.14	0.79	0.12

In this usability questionnaire, the answers were categorized as follows: score to 0.9 (strongly disagree) between 1 and 1.9 (disagree), 2 to 2.9 (Neutral), of 3 to 3.9 (I agree) and equal to 4 (Strongly Agree). According to Table 2 we observed that, about 73.3 % of the questions have no significant difference from the mean of students score in two semesters. Only the questions 02, 04, 06 and 10 had significant differences between the mean of two semesters.

In relation to the consistency criterion (questions 5 and 6) we can observe in Table 3 that the answers of the two questions were similar with the opinion of all students. Students had not an opinion regarding to the integration of functions on Facebook but in relation to consistency, they disagreed (1.29) or disagree completely (0.83) that Facebook was inconsistent but there was a significant difference between the means of two classes (p-value = 0, 32.10–3, $p < 0.05$). This fact shows that the objects and functionalities of Facebook do not change.

The criterion of recognition instead of memory (questions 7 and 10) was more relevant because the students of both semesters totally disagree (1.39) or disagree (0.94) that should learn a lot of things before you continue using Facebook. This criterion had a significant difference between the means of two semester (p-value = 0.01, $p < 0.05$).

The mean of students score for the criterion of aesthetic and minimalist design (issues 11, 12) was approximately 3.00 and have no difference in both two semesters without significant difference of mean (question 11: p-value = 0.39 and question 12: p-value = 0.56, $p > = 0.05$). The criteria of questions 12 (easy to use) and 15 (organization of the information) had the mean score of responses from students of both semesters 3.01(agree) meaning that the organization of information in Facebook screen is clear and it was easy to find a specific information with no significant difference in the mean between the two semesters (p-value = 0.56 and 0.12, $p < 0.05$).

In relation to the user control criterion, the mean score of the students was 3.14 and 3.01 (agree) meaning the form of interaction with the Facebook is nice and no significant differences between the mean of the two semesters (p-value = 0.20, $p < 0.05$). On the other hand the students totally disagreed (0.87 and 0.57) that needed help from another person to use Facebook as a learning tool.

Finally, the user experience criteria and also the questions related to the objective of this research can be observed in questions number 1, 2, 3, 8, 9 and 13. We concluded that the mean score of the opinions of students of both classes are close to a good acceptance of Facebook usability as a learning tool.

4 Discussion

According to some students' opinions, we can note that the use of ICT in education is important and critical to student learning because professional training can no longer be limited to the classroom and to decontextualized knowledge production. This can be seen by [17] where he described the education model in which

characterizes that the information and knowledge society will probably not be based on Education, classroom or distance, it will be based on learning. Consequently not will be a model of distance education, but probably a model of Technology-Mediated Learning.

We also observed through the comments that although users have low affinity in using social networks as support learning tool, but there was a strong motivation and interest among them in both classes to use Facebook. The phenomenon of motivation through the emergence of a new feature has been proven in the literature by other authors [18–20].

In the qualitative analysis of the open question held with students we observed some difficulties such as the habit of not using frequently social networks. Students who do not have the habit of accessing Facebook had access to materials through classmates but nevertheless found it very easy and useful the use Facebook in the discipline and thus were able to update on the health informatics discipline.

The results of the questionnaire of the two classes also showed that students' opinions were not as different. It has been seen that most students considered that the types of interaction with the Facebook was easy and pleasant and the group of the discipline created on Facebook allowed the teacher to use different methodologies to encourage and motivate students in their study process, thus being allowed to build, customize, enhance and add meaning to learning becoming more flexible.

Good initiatives like these are necessary. Nobody can ignore the quantity and quality of information circulating in the virtual spaces. The groups of disciplines created on Facebook increase the student stimuli in cooperative learning, causing an adaptation of man to his environment, favoring collective learning and enabling the sharing and expansion of knowledge outside the classroom.

This paper presented the benefits of social networks for the educational context and demonstrated how Facebook can be applied in this context as a teaching and learning tools using the tool groups that should implement alternatives that complement the educational experience outside the classroom.

5 Conclusion

We present a new trend in the use of social networks as support of the teaching-learning in the information technology discipline of undergraduate course of nursing. Through a study case was possible to answer the research question of this study. The social network Facebook was used as an interactive tool to view all content of the discipline by integrating the principles of learning with interdisciplinary theory of computer supported cooperative work.

With the results we noted that the use of information technology and social networks was not a common habit in an undergraduate course of the nursing course but they provided significant benefits for learning, for improved teaching process,

facilitating the exchange of information, where the objective is not just to share, but also build a form of interaction between students.

Although only a part of the participants of the experiment used the Facebook as a support tool for learning, the results of this study corroborate the analysis of usability and learning. However, there is evidence that users' preference in the order of 95.5 % in favor of the use Facebook as teaching support tool and relate it to its simplicity as evidenced by the words of some participants in the analysis section of satisfaction. Regarding the variable usability, the students, despite having the non-technological profile, liked to use Facebook as support tool for learning and felt more satisfied and updated with the contents of the discipline.

The contributions provided in this study were related to the analysis of usability Facebook and improvement in learning due to of its use, because it was possible to perform the analyzes in real scenarios in the context of informatics discipline in nursing program, creating an opportunity for discussion and reflection on the use of social networks as a support tool in the teaching and learning process.

References

1. Capobianco, L.: Comunicação e Literacia Digital na Internet Estudo etnográfico e análise exploratória de dados do Programa de Inclusão Digital Acessa SP–PONLINE. Dissertation (Master in Communication Science). School of Communication and Arts, University of São Paulo (2010)
2. Jonassen, D.: Computers as mindtools for engaging critical thinking and representing knowledge. Duke University, Durham. http://frank.itlab.us/forgetting/learning_mindtools.pdf. (2000). Accessed 30 June 2014
3. Jonassen, D.: Using cognitive tools to represent problems. J. Res. Technol. Educ. **35**(3), 362–381 (2003)
4. Tomaél, M.I.: Redes sociais, conhecimento e inovação localizada. Inf. Inf., Londrina, **12**, n. esp. (2007)
5. Schulte, S.J., Sherwill-Navarro, P.J.: Nursing educators' perceptions of collaboration with librarians. J Med Libr Assoc. http://www.ncbi.nlm.nih.gov/pmc/articles/PMC2605025/ (2009). Accessed Jan 2015
6. Fonseca, L.M.M. et al.: Serious game e-Baby: percepção dos estudantes de enfermagem sobre a aprendizagem da avaliação clínica do bebê prematuro. Rev. Bras. Enferm., Brasília, **68**(1), 13–19, 2015. http://www.scielo.br/scielo.php?script=sci_arttext&pid=S0034-71672015000100013&lng=en&nrm=iso (2015). Accessed 13 Nov 2015 http://dx.doi.org/10.1590/0034-7167.2015680102p
7. Solares, I., Carvalho, L.: Análise Estatística Da Percepção De Estudantes Brasileiros De Ensino Médio Sobre Os Efeitos Das Tecnologias Na Promoção Do Conhecimento. in: II Congresso Internacional TIC e Educação. pp. 1208–1221. (2012)
8. Rocha Junior, V., Sarquis, A.B., Sehen, S.: Uso de mídias sociais no setor de ensino superior. Revista Brasileira de Gestão e Inovação, **1**(2), 25. Disponível em: http://www.ucs.br/etc/revistas/index.php/RBGI/article/view/2442 (2014.) Acesso em: 18/09/2015
9. Tasir, Z., Al-Dheleai, Y.M.H., Harun, J., Shukor, N.A.: Student's perception towards the use of social networking as an e-learning platform. recent research in education, 70–75. In: Proceeding of The 10th WSEAS International Conference on Education and Educational Technology (EDU'11), pp. 70–75 (2011)

10. Dias, R.B.F. et. al.: Uso de redes sociais no ensino superior: análise em um curso de Bacharelado em Enfermagem. In: CONGRESSO INTERNACIONAL DE EDUCAÇÃO À DISTÂNCIA, 18, 2012, São Luiz. Anais eletrônicos. São Luiz, UFMA (2012)
11. Ferreira, J.L., Correa, B.R.P.G., Torres, P.L.O.: uso pedagógico da rede social Facebook. Redes Sociais e Educação. Colabor@ (Digital), **7**(28). Disponível em: http://pead.ucpel.tche.br/revistas/index.php/colabora/article/view/199 (2012). Acesso em: 03/07/2015
12. Moraes, R.C.R., Bicalho, M.G.P., Souza, M.C.R.F.: Ciberespaço e ensino superior: um estudo sobre as práticas educativas. In: FORUM INTERNACIONAL SOBRE PRÁTICA DOCENTE UNIVERSITÁRIA, 2, Uberlândia. Anais eletrônicos… Uberlândia, UFU, 2012. Disponível em: www.forumdocente.prograd.ufu.br/anais.pdf (2012). Acesso em: 03/07/2015
13. Merriam, S.B.: Qualitative Research and Case Study Applications in Education. Jossey -Bass Publishers, San Francisco (1998)
14. Preece, J., Rogers, Y.S.E.: Design de Interação, 1st edn. Bookmark, Porto Alegre (2005)
15. Nielsen, J.: Usability Engineering. Academic Press Professional, Boston (1993)
16. Bastien, J.M.C., Scapin, D.L.: Ergonomic criteria for the evaluation of human-computer interfaces. INRIA, Rocquencourt, France (1993)
17. Panseri, A.A.C.: Uso da TIC na Educação. http://www.webartigos.com/articles/29205/1/USO-DA-TIC-NAEDUCACAO/pagina1.html (2009). Accessed Apr 30 2011
18. Hullman, J., Adar, E., Shah, P.: Benefitting InfoVis with visual difficulties. IEEE Trans. Vis. Comput. Graphics 213–2222 (2011)
19. Adelman, H.S., Taylor, L.: Student engagement and disengagement: an intrinsic motivation perspective and a mental health concern. In: Waller, J. (ed.) Mental Health Promotion in Schools. Benthem Science, Sharjah, UAE (2012)
20. Seipel, S., Carvalho, L.: Solving combined geospatial tasks using 2D and 3D bar charts. In 16th International Conference on Information Visualisation, pp. 157–163 (2012)

ICT Classroom LMSs: Examining the Various Components Affecting the Acceptance of College Students in the Use of Blackboard Systems

Sara Jeza Alotaibi

Abstract A number of different academic departments at both college and university level implement Learning Management System such as Blackboard System in an effort to achieve economical improvements to course management. ICT initiatives in universities also are known to have implemented this method. Nonetheless, the successful adoption of the Blackboard System in IT Graduation Project courses necessitates that students in such fields accept the system. The UTAUT (Unified Theory of Acceptance and Use of Technology) model has been applied in mind of examining the various factors known to effect the acceptance and use of the Blackboard system by students in IT Graduation Projects, which are known to comprise lab and theoretical lectures [4]. Moreover, this work seeks to represent ICT college students' views on the various aspects known to effect the rejection or acceptance of such a system. With this in mind, a sample of 51 ICT college students was involved in the study, with ten focus group discussions carried out. The subjects communicated five key elements as impacting the application of the Blackboard System in the specific arena of IT Graduation Project classes in the KSA's Taif University, namely effort expectancy, facilitating conditions, lab practice, performance expectancy and social influence.

Keywords Blackboard system · LMS · UTAUT · ICT · Learning management system

1 Introduction

Across the globe, educators have increased their application of IT in class preparation, instruction deliverance and student information administration [1]. Moreover, online learning—commonly referred to as e-learning, in addition to a number of

S.J. Alotaibi (✉)
e-Learning and Distance Learning, College of Computer Sciences and Information Technlogy, Taif University, Taif, Saudi Arabia
e-mail: Sara.alotaibi@tu.edu.sa

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different incorporations of e-learning with traditional classrooms—is increasing, with this new approach to studying, contrasting with conventional in-person learning, recognised as an innovative method of carrying out learning activity without restrictions in terms of time and place [2]. Flip teaching, or flipped classroom, is a valuable example of how more conventional learning has been integrated with e-learning [3]. More specifically, the Blackboard System is regarded as being the most valuable Learning Management System (LMS), and is receiving much attention in the higher education field. A number of different academic departments at both college and university level implement this system in an effort to achieve economical improvements to course management. ICT initiatives in universities also are known to have implemented this method. Nonetheless, the successful adoption of the Blackboard System in IT Graduation Project courses necessitates that students in such fields accept the system.

The UTAUT (Unified Theory of Acceptance and Use of Technology) model has been applied in mind of examining the various factors known to effect the acceptance and use of the Blackboard system by students in IT Graduation Projects, which are known to comprise lab and theoretical lectures [4]. Moreover, this work seeks to represent ICT college students' views on the various aspects known to effect the rejection or acceptance of such a system. With this in mind, a sample of 51 ICT college students was involved in the study, with ten focus group discussions carried out. The subjects communicated five key elements as impacting the application of the Blackboard System in the specific arena of IT Graduation Project classes in the KSA's Taif University, namely effort expectancy, facilitating conditions, lab practice, performance expectancy and social influence. The subjects recognised the Blackboard System as having the capacity to enhance the overall efficiency of their study and its learning skills, providing a number of valuable learning resources and ensuring the provision of emotional encouragement. This performance expectancy was regarded as being the most fundamental of reasons in the application of the Blackboard System. It was stated that ease of use, or effort expectancy, was the second most important reason behind application. Furthermore, facilitating condition and social influence were viewed as the supplementary factors affecting Blackboard acceptance amongst students. The findings give some insight into recommendations for educational administrators and course management developers, all of whom may hold an interest in the use of such a system when teaching ICT students in the field of IT Graduation projects.

2 Research Problem

A number of higher education ICT programs have been implemented or are in these stages, with LMSs recognised as a new and innovative computer-aided learning instrument in the context of e-learning settings. Analysing the rationale behind adopting LMSs, from a learner's perspective can be pivotal in increasing the knowledge and understanding of ICT learners in regards their utilisation intensions

and behaviours concerning this fundamental e-learning system. Through the application of the Unified Theory of Acceptance and Use of Technology (UTAUT), the present work is carried out with a theoretical foundation. Moreover, through placing emphasis on focus group discussions, this work provides more in-depth results through assisting in expanding knowledge in regards to ICT learners' acceptance and overall adoption of learning technologies.

This work aims at analysing the various elements that are known to affect the interactions of ICT students with Blackboard System through the utilisation of the UTAUT model. The UTAUT model originally was devised in line with prior classic technology models, and has undergone validation through the completion of a longitudinal study with almost 70 % explanation power [5], thus positioning it as a concise tool aimed at measuring users' potential to implement a new technology. Moreover, this work seeks to explain the reasons provided by ICT students in either accepting or rejecting the use of the Blackboard System; this, in turn, emphasises the attitudes and views of students regarding the Blackboard in particular, and LMSs overall, in the context of Graduation Project classes. In this vein, the perspectives of learners might fall into the UTAUT model or otherwise might be seen to relate to mediating factors.

Focusing on the UTAUT model, the study questions were devised in mind of analysing the various viewpoints of ICT learners on the factors affecting their overall acceptance of the Blackboard System. These are detailed as follows:

1. Does the performance expectancy of ICT learners influence their implementation of the Blackboard System in the case of IT Graduation Project classes?
2. Does the effort expectancy held by ICT learners have an effect on their subsequent use of the Blackboard in IT Graduation Project classes?
3. What facilitating conditions impact ICT learners' overall utilisation of the Blackboard System in the case of IT Graduation Project classes?
4. How does social influence effect ICT learners' utilisation of the Blackboard System in regards IT Graduation Project classes?
5. Are there any other factors that motivate the adoption of the Blackboard System by ICT learners in the IT Graduation Project classes?

In an effort to seek to establish the potential factors exerting influence on the adoption behaviours of ICT students in relation to a learning management system (LMS) in computer classes, a model was devised in line with a complete technology acceptance theory. Furthermore, in line with the aim of garnering in-depth understanding of how such influential factors work on students, there was the formation of semi-structured interviews, as well as a questionnaire, so as to allow students to provide more of their thoughts. Despite the fact that the results and subsequent implications are detailed on the basis of only a case study, a more in-depth understanding of ICT learners' views and opinions on LMS, and their overall acceptance of these systems, was garnered throughout the course of the study. This work does not seek to provide insight into only whether those factors incorporated in the UTAUT model account for ICT learners' adoption behaviours, but also

pertaining to the feelings of users underpinning all factors that could cause their behaviours to be impacted.

3 Proposed UTAUT Model

A technology's success not only depends on the good reviews or revenue generated, but also on the elements that can assist in someone understanding the level of acceptance that can be garnered from technology. The section below considers the design and use of a model in calculating the degree to which the acceptance of the Blackboard System, amongst ICT college students, can be explained, predicted and understood.

The UTAUT model was developed by Venkatesh through the completion of a comparison concerning the overall efficiency of the eight theoretical models in the IT systems of four different industries, including two mandatory and two voluntary systems [5]. It was established that these include effort expectancy, performance expectancy, social expectancy and the necessary facilitation. All of these individual elements are recognised as direct antecedents of the information system-related behaviour of a user [5].

User demographics, such as age, experience, gender and willingness to use (voluntarism), are taken into account through the adoption of this theory [5]. This model is known to have three distinct features, namely determinants, modifiers and results. The model's outcome is user behaviour. A number of the demographics were recognised as modifiers, such as in the cases of age, experience and gender. The three key determinants affecting individuals' behavioural intentions are effort, expectation and performance expectancy. Moreover, there also were facilitating conditions as a determinant that has a direct impact on user behaviour.

As has been discussed in the work of Pardamean and Susanto [6], direct determinants of intentions can be defined as follows:

- Effort expectancy is explained by Venkatesh et al. as the degree of ease associated with the technology or system's use [5]. This factor is recognised as comprising three individual elements, namely actual ease of usage, level of complexity and perceived ease of use [8]. It is fundamental that the effort necessary for using or otherwise learning the technology is lowered in an effort to ensure the development of user intention to apply the system.
- Performance expectancy is recognised as a multi-faceted domain comprising five different elements, namely extrinsic motivation [7], job fit, outcome expectations, perceived usefulness and relative advantage [8]. It is essential that the individual's performance expectancy in regards to a particular technology or system is increased in order to ensure improved opportunity for its incorporation is initiated across the individual's routine.

- Social influence is described by Venkatesh et al. as being the extent of belief possessed by the individual in relation to the particular system or technology being appropriate and well suited to the usage of surrounding people, i.e. those the individual considers important [5].

In the view of Venkatest et al., four individual moderators are included in the UTAUT model, namely age, experience, gender and voluntariness (see Fig. 1) [5]. In line with such probable influences, the study seeks to assess the influence of age, experience and gender in relation to computers and internet technology concerning the utilisation of the Blackboard System for Graduation Projects classes. The UTAUT review provided further establishes that the overall acceptance of the model necessitates the need to further widen the frontiers of determinants of user acceptance to different contexts. Moreover, the suggestion has been made by Venkatesh et al. [5] that the need to extend the UTAUT model through achieving more in-depth understanding of the dynamics affecting user acceptance in technology is pivotal. This can be achieved through establishing the various constructs that might add to the prediction of behaviour and intention to use beyond what has already been established and what is already known (i.e., Lab Practice).

Owing to the fact that lab practice is recognised as one of the most pressing factors required for examining IT Graduation Project classes in the KSA's Taif University, this study seeks to apply the lab practices as an external variable in mind of acting as direct determinants of user behaviour and intention in the original model, as detailed in Fig. 2.

In consideration to the figure above, it may be emphasised that the Blackboard System, in the context of Graduation Project classes, may be influenced in terms of its intention to use through various factors, namely effort expectancy, facilitating conditions, lab practice, performance expectancy and social influence. Furthermore,

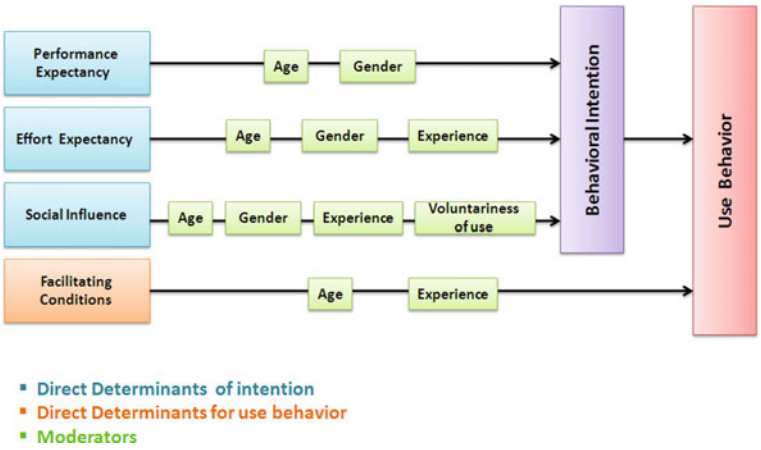


Fig. 1 The original UTAUT

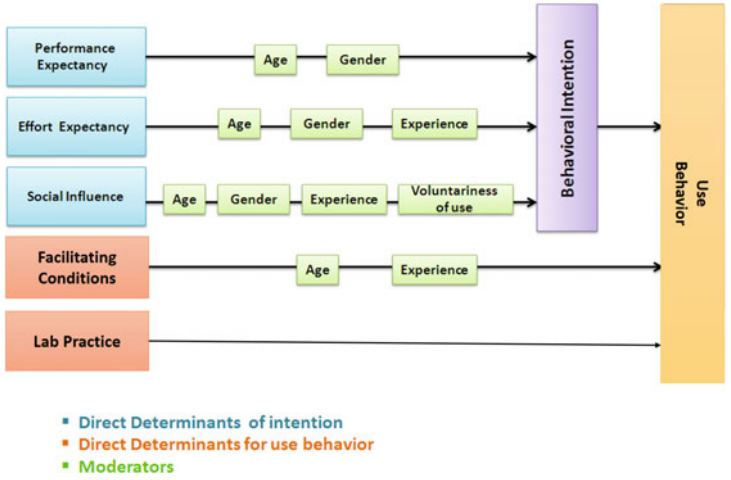


Fig. 2 Lab practice implemented as external variables to direct determinants of intention and for use behaviour, as detailed in the original UTAUT model

there also may be the suggested that a key intention to use any LMS eventually can be translated into the system's actual adoption.

Although the present work centres on effort expectancy, facilitating conditions, lab practice and performance expectancy, there are a number of other elements requiring further examination. The Fig. 3 provides the hypotheses to be tested in regards the Blackboard System for Graduation Project classes.

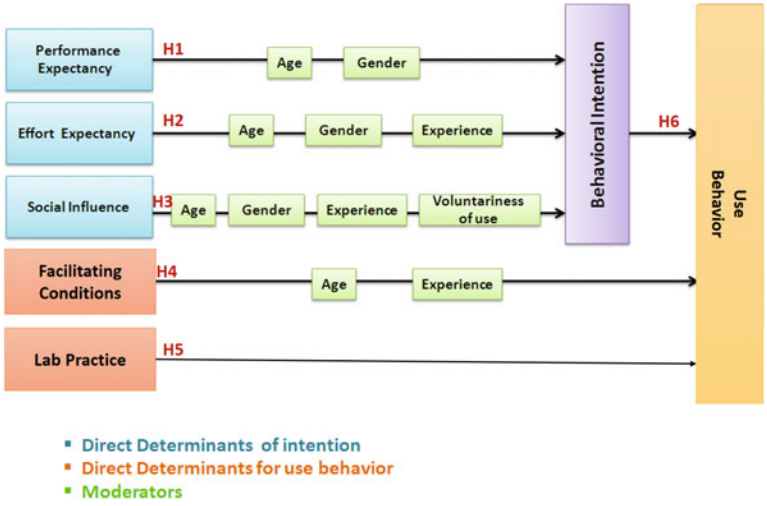


Fig. 3 Hypotheses to be applied to test the Blackboard System in this work

It has been stated by Sekaran and Bougie that the initial step in the measurement of the construct is to ensure the construct's overall premise and scope are defined [9]. Moreover, an explanation was provided by Al-Qeisi in relation to the differences between construct and variable, and further emphasised that measurement is the only element to be applied in order to achieve differentiation [10]. Sekaran and Bougie are quoted by Al-Qeisi when explaining that an actual measure's presence means the construct becomes a variable [9, 10].

Statements and constructs recognised as relevant to the study are applied by Venkatesh et al. [5], with new statements associated with the new variable incorporated by the researcher in an effort to provide more in-depth clarity. All of the statements are assessed with the use of a five-point Likert scale spanning strongly disagree (1) to strongly agree (5).

4 Results and Discussion

In study methodologies, such as in the case of the current work, where there is the use of survey research designs, a sample's information is fundamental to the study in consideration to primary data collection. Internal validity issues also depend on the sampling method applied, in addition to the sample size chosen for the research [11]. Overall, the sample is seen to represent a population of individuals with whom the researcher interacts in order to gather data [12]. In some contexts, the sample size also is referred to as respondents or participants. Essentially, academic sources and literature have emphasised that the number of individuals included in a sample requires a survey, which is critical to the overall reliability and internal validity achieved by the study. Overall, there are two schools of thought in this regard: the first of these suggests that the most suitable number of people to be included in a sample needs to be proportional to the number of people in the population, where the sample size needs to be an estimated 20 % of the total population [13]; the second school of thoughts to be used in the case of this study, however, suggests that a generalised target of one hundred (100) respondents, as a minimum, is considered suitable when striving to garner valuable results. Accordingly, this study utilises 20 % of the ICT students who have studied IT Graduate Project classes at Taif University in the KSA, spanning the period September 2014–December 2015. Furthermore, a total of 51 respondents were used by the researcher, which is considered to be a notably acceptable value.

The results are organised as follows: the first section provides a statistical analysis of the subjects involved in the survey, with the survey results subsequently analysed with the use of SPSS and AMOS version 20, with the relationships between variables in the conceptual UTAUT-based model undergoing evaluation in regards to the use of the Blackboard System for Graduation Project classes. This then can be linked to the hypotheses testing. Lastly, the fit of the model is addressed through analysing the indices tables created as a result of the analysis.

A richer understanding of the thoughts of ICT learners, and what they believe to have influenced their acceptance of the Blackboard System, was achieved through the qualitative research approach, where the subjects in this study were academic major, academic status, homogeneous in age, computer background, experience in LMS use and internet usage. Most of the subjects had remained in the ICT program for a minimum of 3 years, with the sample making up 100 % females. In regards to data collection methods, the topic was examined in-depth through the use of focus group discussion, with observations also carried out as a means of achieving participants' input validation. Data-driven and template analytical inductive methods were implemented in mind of data analysis across the four focus groups [14, 15]. Accordingly, there was the establishment of categories and subcategories.

Effort expectancy, facilitating conditions, lab practice, performance expectancy and social influence were recognised by the subjects as elements affecting their overall acceptance of Blackboard in their classes. With this noted, attention is now directed towards the study questions: Does the performance expectancy of ICT learners influence their implementation of the Blackboard System in the case of IT Graduation Project classes? Does the effort expectancy held by ICT learners have an effect on their subsequent use of the Blackboard in IT Graduation Project classes? What facilitating conditions impact ICT learners' overall utilisation of the Blackboard System in the case of IT Graduation Project classes? How does social influence effect ICT learners' utilisation of the Blackboard System in regards IT Graduation Project classes? Are there any other factors that motivate the adoption of the Blackboard System by ICT learners in the IT Graduation Project classes? The results garnered suggest that both effort expectancy and performance expectancy had an influence on the acceptance of Blackboard amongst the ICT students. In this same vein, facilitating conditions also was found to influence their adoption, with social influence also recognised as a driving factor. In relation to external factors outside of the UTAUT model that could have affected the adoption of Blackboard amongst the students, lab practice was recognised; this is considered to be one aspect that affects adoption in the specific context of this study. Moreover, half of the students considered performance expectancy as the most pivotal consideration influencing their use. The second most important factor was seen to be effort expectancy, as stated by 30 % of the sample. Meanwhile, 20 % of the subjects believed facilitating conditions and social influence improved their overall acceptance of the system. Notably, it was mentioned by six of the students, who had experience with Blackboard or another LMS, that their good impressions with such systems made them more likely to adopt another LMS. Participants' interactions were observed throughout the focus group discussion, which emphasised the attitudes and feelings of students in the use of Blackboard, which, at the same time, provided a more wide-ranging understanding of the utilisation and rejection of such learning systems. As an example, regardless of whether the participants were not so verbally explicit or whether they were dominant, all individuals were able to express their views, with the discussion flow emphasising that it was essential to direct attention and ensure all students had understanding of the questions posed.

The current work has the aim of examining the individual elements known to affect ICT students' involvement with LMSs, specifically Blackboard, in this case, through the adoption of the UTAUT model. As is shown through the findings, the study subjects were affected by five key factors, namely effort expectancy, facilitating conditions, lab practice, performance expectancy and social influence.

The study presented has a number of implications for educational administrators and teachers in the domain of ICT through Blackboard adoption. As is indicated by the findings, the key factors affecting the acceptance and subsequent use of Blackboard amongst ICT students were effort expectancy, facilitating conditions, lab practice, performance expectancy and social influence, with these findings providing further validation for the UTAUT model through the lens of a qualitative work. The study further established that former practice, i.e. the prior use of an LMS that affects the views of the user, influenced the adoption of Blackboard by users in the Graduation Project classes. The implications centre on how ICT students' acceptance of Blackboard in the context of Graduation Project classes can be increased.

5 Conclusion and Future Work

This study aims to represent college students in the ICT domain on the numerous elements recognised as impacting the acceptance of rejection of a system such as Blackboard. Accordingly, a total of 51 ICT students were recruited for the study, with the completion of ten individual focus group discussions. It was found that there are five key factors affecting Blackboard implementation in the field of IT Graduation Project classes in Taif University in Saudi Arabia, namely effort expectancy, facilitating conditions, lab practice, performance expectancy and social influence.

The study has a number of limitations to be noted, one of which is the technique of the focus group discussions. Primarily, the relatively small number of subjects can mean the sample's overall representativeness may be reduced, which causes problems in generalising the results of a larger population. Accordingly, this work may be regarded only as a case study. As a second consideration, the subjects recruited were limited to ICT students only, notably those with a high level of computer background and who had studied for 3 years at the KSA's Taif University's ICT college. This restriction can mean the representativeness of the sample is reduced. Accordingly, it is hoped that the sample can be expanded in the future so as to include a more wide-ranging sample, including ICT learners at lower computer ability levels, as well as those at higher levels enrolled in any form of computer course. Lastly, owing to the subjects not feeling comfortable with the presence of audio-recording devices, the focus group discussions were not recorded, meaning the conversations had to be recorded by hand. With this noted, it is possible to suggest that the researcher missed information or ideas that were communicated. In line with the study findings, further research on the factors believed to affect ICT college students' acceptance and subsequent utilisation of

Blackboard in their Graduation Projects class could seek to address the various restrictions discussed above, in addition to other areas. For example, the study's small sample size calls into question the findings' explanatory power, with subsequent studies performed in this field possibly able to test this concern. Secondly, interviews and discussions could be audio-recorded so as to ensure a complete script can be created, which would provide further validation concerning the study findings. However, regardless of the study limitations, this research has highlighted a number of important considerations in the domain of ICT and the use of LMSs. Further researches, nonetheless, could be useful in emphasising and solidifying the findings.

References

1. Carswell, A.D., Bojanova, I.: E-learning for IT professionals: the UMUC experience. IT Professional **13**(6), 16–21 (2011)
2. Kihoro, J.M., Oyier, P.A., Kiula, B.M., Wafula, J.M., Ibukah, R.W.: E-learning eco-system for mobility and effective learning: a case of JKUAT IT students. In: IST-Africa Conference and Exhibition (IST-Africa), 2013, pp. 1–9, 29–31 May (2013)
3. Elliott, R.: Do students like the flipped classroom? An investigation of student reaction to a flipped undergraduate IT course. In: Frontiers in Education Conference (FIE), 2014 IEEE, pp. 1–7, 22–25 Oct (2014)
4. Sumak, B., Polancic, G., Heričko, M.: An empirical study of virtual learning environment adoption using UTAUT. In: ELML'10. Second International Conference on Mobile, Hybrid, and On-Line Learning, 2010, pp. 17–22, 10–16 Feb (2010)
5. Venkatesh, V., Morris, M., Davis, G., Davis, F.: User acceptance of information technology: toward a unified view. MIS Q. **27**(3), 425–478 (2003)
6. Pardamean, B., Susanto, M.: Assessing user acceptance toward blog technology using the UTAUT model. Int. J. Math. Comput. Simul. **6**(27), 203–212 (2012)
7. Davis, F.D.: Perceived usefulness, perceived ease of use, and user acceptance of information technology. MIS Q. **13**(3), 319–340 (1989)
8. Moore, G., Benbasat, I.: Development of an instrument to measure the perceptions of adopting an information technology innovation. Inf. Syst. Res. **2**(3), 192–222 (1991)
9. Sekaran, U., Bougie, R.: Research Methods for Business, 5th edn. Wiley (2009)
10. Al-Qeisi, K.: Analyzing the use of UTAUT model in explaining an online behaviour: internet banking adoption. Brunel University (2009)
11. Taylor, S.: Marketing Decomposition and crossover effects in the theory of planned behavior: A study of consumer adoption intentions. Int. J. Res. Mark. **12**(2), 137–155 (1995)
12. Krejcie, R.V., Morgan, D.W.: Determining sample size for research activities. Educ. Psychol. Measur. **30**, 607–610 (1970)
13. Stat, T.: Sample Size: Simple Random Samples. http://stattrek.com/sample-size/simple-random-sample.aspx. Accessed May 1 2016 (2012)
14. Crabtree, B., Miller, W.: A template approach to text analysis: developing and using codebooks. In: Crabtree, B., Miller, W. (eds.) Doing Qualitative Research, pp. 163–177. Sage, Newbury Park, CA (1999)
15. Boyatzis, R.: Transforming Qualitative Information: Thematic Analysis and Code Development. Sage, Thousand Oaks, CA (1998)

Intelligence Training Research Exercise 15-1

Meghan T. Berlingo, Lisa Tripp and Justin Wilson

Abstract The development of effective team training systems has a high degree of complexity. It is critical to balance fidelity for trainees and usability for trainers while optimizing training effectiveness. This paper focuses on the methodology leveraged to elicit the empirical data through a training specific study called a Training Research Exercise (T-REX). T-REX 15-1 kicked off the first combined user evaluation of the three primary components of the Distributed Common Ground System Weapon System Trainer (DWST). Thirteen individuals from the 480th ISR Wing, 27th Intelligence Squadron (IS), Distributed Ground Station-Indiana (DGS-IN), and the National Air and Space Intelligence Center (NASIC) participated in a 4 day training event to evaluate the usability and fidelity of the DWST. Descriptive statistical analyses were performed on the data for the three different measures across all participants; crew trainer fidelity ($M = 3.71$, $SD = 0.30$), crew trainer usability ($M = 3.69$, $SD = 0.41$), and overall training experience ($M = 3.43$, $SD = 0.42$). Results indicate that participants from all groups were satisfied with the fidelity and usability of the crew trainer as well as the training experience in general.

Keywords Intelligence · Training · Fidelity · Usability

1 Introduction

The Air Force Research Laboratory's Warfighter Readiness Research Division (AFRL 711 HPW/RHA) coined training research exercises (T-REX) over a decade ago as a proof of concept to demo new training tools and technologies. Through the years, T-REX has morphed into an annual miniature exercise to scientifically assess the effectiveness of adaptive training technologies for enhancing C4ISR individual and team performance. Over the past decade, T-REX has been used to support the development and evaluation of mission performance measures and readiness

M.T. Berlingo (✉) · L. Tripp · J. Wilson
Air Force Research Laboratory, Wright Patterson Air Force Base, Ohio, USA
e-mail: meghan.berlingo.1@us.af.mil

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assessment capabilities. Furthermore, these exercises are utilized to capture data that supports the identification and validation of "gaps" in current training programs and capabilities, and provide direction for future readiness training research and development.

The process in which these gaps are identified is called Mission Essential Competency (MEC) approach. This process is used by the United States Air Force (USAF) to offer strategies for knowledge elicitation and validation techniques from Subject Matter Experts (SME's) in order to develop a higher order model of competencies, knowledge, and skills [1, 2]. MECs are high level functions, job contextualized and less general in most cases than competencies found in standard corporate environments [1] and can be formally defined as a "higher-order individual, team, and inter-team competency that a fully prepared pilot, crew, flight, operator, or team requires for successful mission completion under adverse conditions and in a non-permissive environment" [3]. Although MECs are commonly used for training requirements in Air Force Training, the objective is not to target minimum standards of performance for certification but rather utilize a SME centered iterative process that identifies performance and decision-making components that represent a completely competent operator or team [4]. These constructs are then validated across individuals with various levels of experience. The MEC construct is extremely versatile and can be customized to any given position, division, or airframe.

Training Research Exercise (T-REX) 15-1 was hosted at Wright Patterson Air Force Base, OH on 21–25 September 2015 by the Warfighter Readiness Research Division's C4ISR Training Research Team. T-REX 15-1 kicked off the first combined user evaluation of the three primary components of the Distributed Common Ground System Weapon System Trainer (DWST); the DWST is an $18.9 M effort to address one of the 480th Wing's highest priority gaps. Participants came from the 480th ISR Wing, 27th Intelligence Squadron (IS), 497th, DGS-IN, and NASIC to participate in a 4 day training event to evaluate the usability and fidelity of three components of the DWST: a positional training system with content currently focused on geospatial analyst product production tasking (Contextually Relevant Exploitation & Analysis Training Environment (CREATE)), a crew training system with content currently focused on full-motion video crew training (Information Simulation Environment for Training Analysts (ISETA)), and an after-action review capability with functionality to facilitate performance assessment and aid in the identification of training deficiencies (DCGS Process Instrumentation System (DPRINS)).

This paper focuses on crew training and hence we did not analyze the user feedback of CREATE, the detailed discussion will focus on ISETA and DPRINS. The objective of ISETA is to combine training scenarios with immersive experiences using real-world equipment to deliver efficient, effective training to intelligence analysts. The key functional components of ISETA include a scenario authoring tool, scenario execution engine, synthetic role players, and an instructor management station. ISETA enables trainers to utilize recorded and/or simulated

sensor inputs to recreate an environment with a large scope of required analyst activities and interactions for a training event.

DPRINS is a "non-intrusive" data capture (collection and archiving) capability originally designed for process instrumentation and after-action review associated with time sensitive targeting (TST) related information at the Combined Air Operations Center. The tool has a reconstruction capability that portrays event and decision activities which occurred during the execution operation and features an information injection capability enabling instructors to add comments to the data archive. This tool enables trainers to assess what happened during the training event and provide the information required to improve process shortfalls, identify training gaps, highlight efficient work performance, and perhaps most importantly support archiving for after-action review and critically provide instructors the ability to identify and target train shortfalls by applying appropriate training interventions.

T-REX 15-1 was the first T-REX to place the participants and subject matter experts in both the role of a trainee (i.e., the traditional role for subject matter experts) and the trainer (i.e., actually executing the training event for another group of trainees). This facilitated the collection of empirical data to evaluate the current system, not only on dimensions of training fidelity, but also on instructor operator system usability. Researchers and software developers obtained valuable data and direct feedback that facilitated refinement of requirements and vectoring of the maturation of the DWST to meet the 480th's training needs.

T-REX 15-1 was a crucial leap forward in C4ISR Training Research Exercise evolution. It will drive future research in various areas from expansion of mission performance measures and readiness assessment capabilities, to identification and validation of "gaps" in current training programs and capabilities, and direction of future readiness training technologies.

2 Method

T-REX 15-1 leveraged a staggered schedule of participants with each participant first acting as a trainee and later, as trainers over the 4 day exercise. The scenario that the participants trained on was a 1.5 h mission generated by the 27th IS. This was chosen as the methodology to maximize data collection for fidelity and usability purposes of the positional trainer (CREATE), the crew trainer (ISETA), and the after action review capability (DPRINS).

2.1 Participants

Thirteen individuals participated in T-REX 15-1. The participants spanned three different groups including 27th Intelligence Squadron (IS) White Cell, Distributed Ground Station-Indiana (DGS-IN), and National Air and Space Intelligence Center

(NASIC). It should be noted that the NASIC participants chosen were former DGS analysts. Specifically, there were 4 participants from NASIC, 5 from DGS-IN, and 4 from the White Cell. Of these participants, 11 were male and 2 were female. In terms of rank, 1 participant was an Airman, 3 participants were Senior Airmen, 3 were Staff Sergeants, 2 were Tech Sergeants, 1 was a Master Sergeant, 2 were Senior Master Sergeants, and 1 was an Officer. The mean age of the participants was 31.69 with a range of 23–49. The average amount of time the participants have been at their unit was 6.58 years. Lastly, the mean number of years in Air Force Specialty Code (AFSC) was 6.54 years with a minimum of 2 years and maximum of 11 years.

2.2 Materials

The tools that were utilized and evaluated in this training research exercise were Information Simulation Environment for Analysts (ISETA), Contextually Relevant Exploitation Analyst Training Environment (CREATE), and DCGS Performance Instrumentation System (DPRINS) (i.e., the positional trainer, the crew trainer, and the after-action review capability). Subjective data was also captured via fidelity, usability, and experience surveys.

2.3 Procedure

For this event, participants worked through a short 1.5 h mission generated by the 27th IS White Cell and integrated into the prototype positional and team training system. Participants acted as members of DCGS Full-Motion Video (FMV) cell. All participants first ran through the scenario as trainees over the course of 3 days. Furthermore, the White Cell and DGS-IN had the opportunity to sit in the trainer position and run trainees through the scenario. All participants filled out a survey that assessed their opinion on the fidelity of ISETA. The individuals who acted as trainers (WC and DGS-IN) also completed a survey that assessed the usability of ISETA. Finally, participants from NASIC and DGS-IN completed an overall training experience measure as well as receiving an After Action Review (AAR) that was presented in different time frames to examine whether this particular tool had an effect on overall training experience.

2.4 Design

One experimental manipulation (the order of the AAR) was examined on participant's reaction to their training experience. DGS-IN ran through the scenario and then immediately completed their training reaction survey. They received the AAR

following survey completion. On the contrary, participants from NASIC received the AAR immediately following the scenario and completed the training experience survey last.

This effort provided preliminary data to assess the usability and functionality of three different components (i.e., the positional trainer, the crew trainer, and the after-action review capability) of the DCGS Weapons System Trainer.

3 Results

Descriptive statistical analyses were performed on the data for the three different measures across all participants; ISETA fidelity (M = 3.71, SD = 0.30), ISETA usability (M = 3.69, SD = 0.41), and training experience (M = 3.43, SD = 0.42). See Figs. 1, 2 and 3.

An independent samples t-test was conducted to examine whether the order in which the AAR was delivered influenced a participants training experience. Results suggested that there was no significant differences between NASIC (M = 3.16, SD = 0.51) and DGS-IN (M = 3.66, SD = 0.16) (the two groups who received the AAR), t(7) = −2.089, p = 0.08 on their training experience; although, DGS-IN did have a higher average training experience score than NASIC.

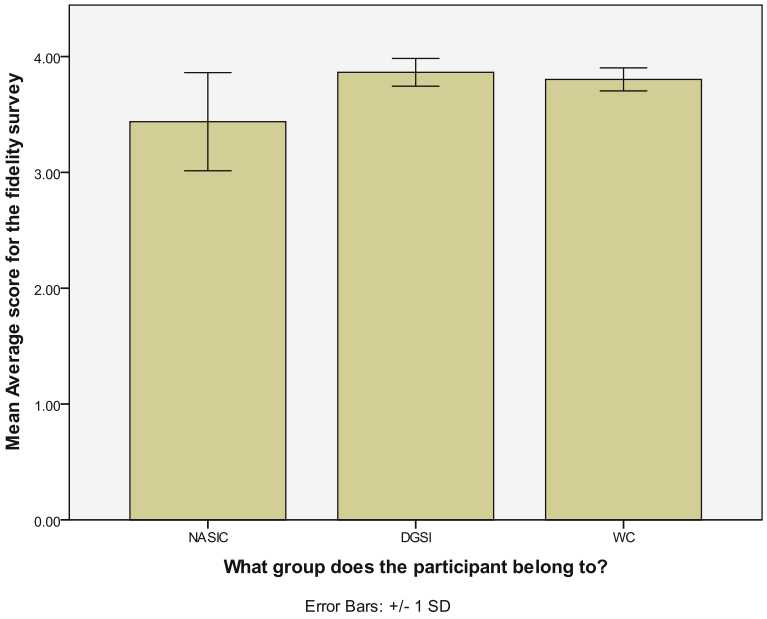


Fig. 1 Average fidelity (trainee perspective) score for ISETA across the three group

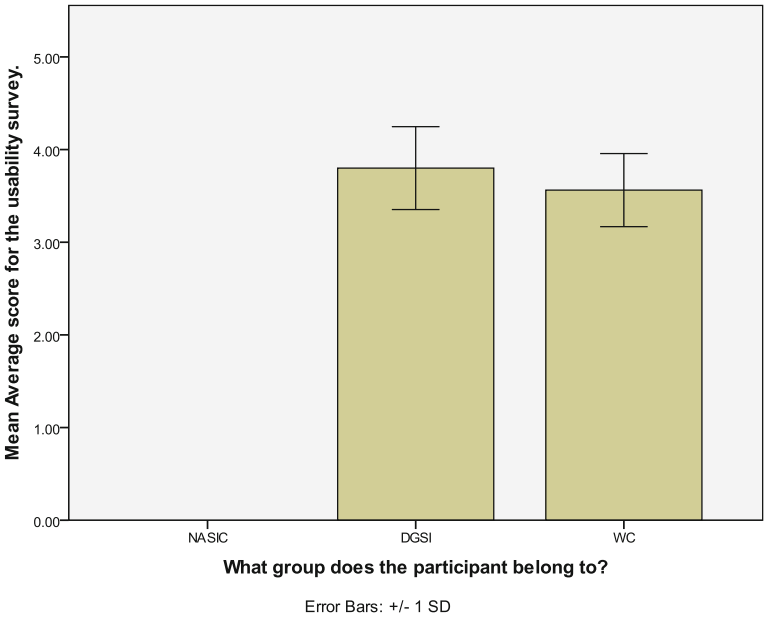


Fig. 2 Average score for the usability (trainer perspective) of ISETA across two groups. There was no data for the NASIC participants as they did not participate as trainers

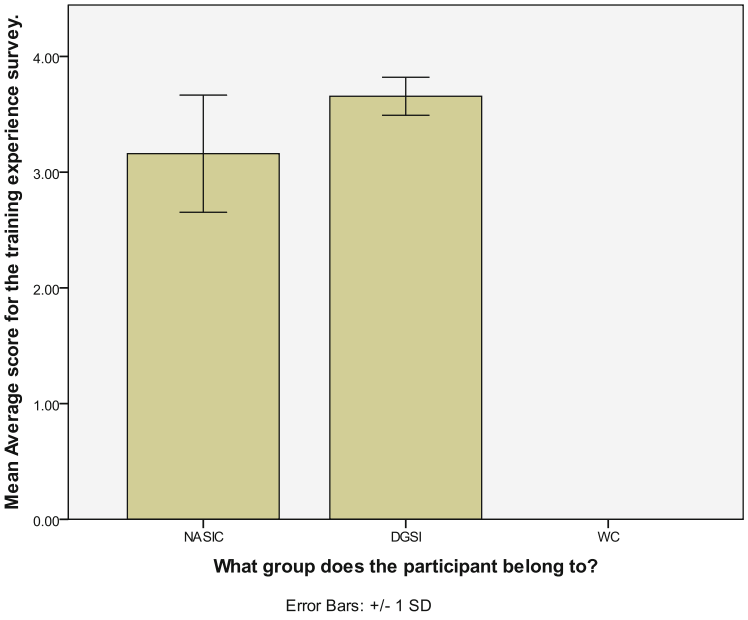


Fig. 3 Average score on the training experience survey. There was no data for the WC participants as they did not take the training experience survey

For exploratory purposes, a one-way ANOVA was conducted to examine whether opinions about fidelity of ISETA varied across groups. There were no significant differences across the three groups, $F(2, 10) = 3.59$, $p = 0.07$. Similarly, another independent samples t-test was performed to see if there were differences across groups in regards to the usability of ISETA. Again, there were no significant differences across groups, $t(7) = -0.832$, $p = 0.43$.

4 Discussion

The MEC approach to identifying training gaps [1] has enabled the development of the DWST. Through T-REX's, researchers at the Warfighter Readiness Research Division have been able to evaluate and identify any shortfalls in technology that will aid in future Warfighter training.

Results show that participants from all groups were satisfied with the fidelity and usability of ISETA as well as the training experience in general. All participants scored, on average, above a 3.0 on all measures where the highest possible score was a 4.0.

There were no significant differences between the two groups that received the after action review. This could be attributed to a few things. First, we had a small sample size given the difficulty of recruiting participants in such an applied realm, which ultimately results in decreased statistical power. Furthermore, for the scenario selected, there were limited established performance standards for processes and products; this resulted in the after-action review lacking depth, and may have contributed to the absence of difference in reactions to the training experience.

Overall, TREX 15-1 was a great success with multiple takeaways. The combination of active duty and Air National Guard (ANG) participants added value to the training exercise due to the diversity of age, breadth of experience and input of training needs from both the ACC and Air Force Reserve Command perspective. PatchPlus subject matter experts (SMEs) provided invaluable guidance in regards to Mission Scenario Event List (MSEL) development for the 27th IS. The finalized MSEL for T-REX 15-1 provided a standard for White Cell personnel to leverage for future training scenario execution in conjunction with the DWST. Additionally, PatchPlus will deliver instructional content checklists for new trainers to utilize in training material development.

One of the objectives of T-REX 15-1 was to highlight the significance of incorporating in-depth debriefing for intelligence personnel training (IPT) programs. Since there is a lack of current debriefing guidelines for intelligence trainers, potential solutions could be pre-recorded AARs, debriefing checklist, specialized training for qualified trainers, etc. Finally, certain system limitations need to be addressed prior to T-REX 16-1. AFRL, along with the system developers, will be working diligently with the 27th IS to mitigate any disparities prior to deployment of DWSTv1 planned for January 2016.

T-REX 15-1 demonstrated the importance of utilizing a diverse array of participants who were able to provide valuable feedback from a novice and expert perspective as well as active-duty and reservist stand-point. This aided in the overall development of the DWST for usability and fidelity purposes. Additionally, researchers discovered the value in ensuring a dynamic AAR. This was not necessarily accomplished during this particular study and is something that needs to be addressed and improved in the future.

The main objective will be to measure the effectiveness of adaptive training technologies for enhancing both team and team of teams performance. Each T-REX is used as a vehicle to test the system fidelity and solicit feedback from warfighters to guide future development. In an effort to coincide with the shift of Air Force and ISR collection strategy, Intelligence (INT) T-REX 16-1 scenario development will focus on Contested and Degraded Operations (CDO) environments. Expansion for INT T-REX 16-1 will compensate for both the DCGS and Air Operations Center (AOC), to include DGS crew positions, Intelligence, Surveillance, and Reconnaissance Division (ISR-D), Combat Operations Division (COD), and Senior Intelligence Duty Officer (SIDO)/Intelligence Duty Officer (IDO) team, to simulate real-world intelligence fusion and collaboration and test the integration of multiple testbeds. INT-TREX 16-1 is set to take place in July of 2016.

References

1. Alliger, G.M., Bennett, W., Colegrove, C.M., Garrity, M.J.: Understanding mission essential competencies as a work analysis method. In: Defense Technical Information Center (DTIC). (2007)
2. Colegrove, C.M., Alliger, G.M.: Mission essential competencies: defining combat mission readiness in a novel way. In: NATO RTO Studies, Analysis and Simulation Panel (SAS) Symposium. Brussels, Belgium (2002)
3. Alliger, G. M., Colegrove, C. M., Bennett, W.: Mission essential competencies: new method for defining operational readiness and training requirements. In: 13th International Occupational Analyst Workshop. San Antonio, TX (2003)
4. Tossell, C., Garrity, M.J., Gildea, K.: Developing Expertise at the Operational-Level of Warfare

Visual Cue Streams for Multimodal Dialogue Interaction

Dimitris Koryzis, Christos V. Samaras, Eleni Makri, Vasilios Svolopoulos and Dimitris Spiliotopoulos

Abstract This work examines the visual information streams as feedback to users engaging in multimodal interaction during specific settings. It reports on the findings from complexity and frequency of information presentation paired to user acceptance. It also addresses technical design issues by examining how multiple visual streams are presented in real situations, for the specific complex use case.

Keywords Human factors · Interaction design · Multimodal interaction

1 Introduction

For learning applications, a major parameter to account for is cognitive load [1]. During the design of an instructional system, cognitive load theory (CLT) is part of the human centered design [2]. Such approaches integrate HCI principles with CLT [3, 4]. This is especially evident in web based systems and can be part of the design process [5].

D. Koryzis (✉) · V. Svolopoulos
Hellenic Parliament, Athens, Greece
e-mail: dkoryzis@parliament.gr

V. Svolopoulos
e-mail: v.svolopoulos@parliament.gr

E. Makri
Hellenic Parliament Foundation, Athens, Greece
e-mail: el.makri@parliament.gr

C.V. Samaras · D. Spiliotopoulos
Distributed Computing Systems, Institute of Computer Science,
Foundation for Research and Technology, Hellas, Heraklion, Greece
e-mail: csamaras@ics.forth.gr

D. Spiliotopoulos
e-mail: dspiliot@ics.forth.gr

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Metalogue is an EU-funded project that aims to design a dialogue system with metacognitive capabilities from natural spoken language and multimodal interaction. The goal of the approach is to use multimodal dialogue to help train metacognitive skills in educational settings. In order to do that, Metalogue uses an avatar that engages in multi-issue bargaining with the users via natural language. Specific events that are used for reflection are detected and presented to the users and tutors post-dialogue in order to meaningfully visualize the user progress. In order to design the usability evaluation, three major aspects had to be explored and taken into consideration, the multimodal dialogue, the formal training of specific skills and the overall user experience.

Currently, tutors, as an additional activity to the student formal training at school (debating course), encourage the students to watch recorded debates in order to acquire skills about strategy, presentation, political awareness, as well as social skills. The proposed system builds on the advantage of the multimodal interaction to both drive the dialogue and assess user input. It is also a means for training as well as a complex system. Effectively, the usability evaluation design for such focused system, should include all three aforementioned aspects, multimodal interaction, skill training and overall user experience. This paper presents the experimentation on the visual streams of information, especially in regards to accommodating the particulars for skill training, examining the visual paradigm of real-time multi-source information presentation.

As part of the design of the system-user interaction, this work aims to experiment on the visual cues necessary for the system feedback to the user, exploring the user interaction with the system and the response to the visual signals.

The evaluation settings involve initially student members and their tutors in the debating sessions of the Hellenic Youth Parliament using multimodal interaction, engaging in dialogue in natural language with the avatar agent.

2 Experimental Setup

Five experienced Hellenic Youth Parliament members debated in pairs while the system recorded the session (Fig. 1). An in-action feedback mechanism provided visual feedback to each participant in real time about posture. The sessions lasted 10–15 min each. During the participant interaction the system provided visual real-time feedback according to specific parameters:

- Visual cues (signs) regarding feedback about presentation/posture with variable frequency
- Same as above with fixed frequency
- Multiple visual cues regarding mixed feedback about presentation and progress with variable frequency.



Fig. 1 Pilot session: users debating with system as observer

At the time, the system itself did not present any real-time audio feedback to the users. However, the sessions were recorded and reviewed afterwards as part of the user feedback process.

The goal was to evaluate the load of information presented in real time to the user in order to achieve completeness and informativeness in real time. The user feedback was provided after setting up human-to-human dialogue sessions over a selected topic for political debate. A display and the Kinect module were used to provide feedback on human movement while information from all three aspects was presented when available. The visual notifications were scripted and provided in varying densities. The participants were asked to provide verbal feedback in between short breaks of the debating. Furthermore, they were asked to fill in an online form after the end of all sessions. Each session was adapted by the feedback from the preceding one.

After the debating sessions, the participants were debriefed on the interaction experience and system feedback, mainly on the visual cues during the debate sessions. Furthermore, an online questionnaire survey was compiled and focus group discussions were organized to collect feedback and opinions, in order to better identify the necessary features of the proposed approach. The focus groups involved debate students, politics-oriented tutors of the students, parliamentary officers, policy analysts as scientific advisors, interaction and content designers.

The type and clarity of the visual indicators for the interaction progress were discussed based on the results, while the user acceptance scores for combined complexity and frequency of visual cues were collected from the user feedback session.

3 Results and Evaluation

In order to accurately account for the human experience with multiple visual input over the course of the speech interaction between two participants, the duration of the debating session time was segmented into five second intervals. The times when the visual input was present was addressed within those intervals. For the first session, the visual cue was single and was updated every 10s, that is every 2 segment intervals. The duration of the cues on the screen was 3–5s, which was based on earlier experimentation regarding the complexity of the selected visual itself and the familiarity of the participants. For three sessions, visual cues were presented in variable frequency. For session 1, new visuals were triggered for 50 % of the time segments, since the frequency was fixed. For the variable frequency sessions, the visuals were triggered for 49, 59 and 56 % of the time segments, respectively (Fig. 2).

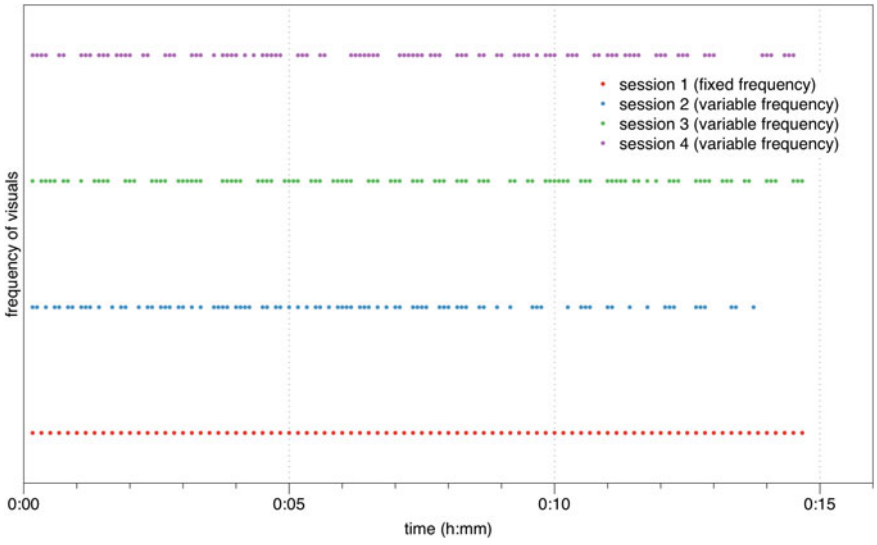


Fig. 2 Session frequency of visuals

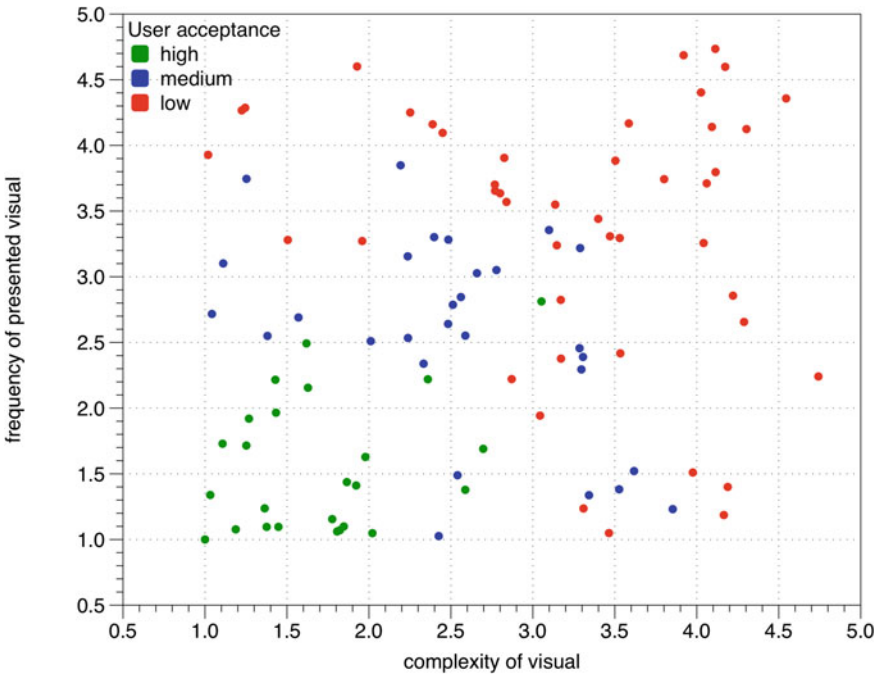


Fig. 3 Perceived complexity and frequency of visuals

The last session involved the use of multiple streams (up to three) of visual cues that were designed to closely resemble the expectations of the final design of the system.

The participants evaluated the perceived level of complexity of the visuals and the frequency that they were presented in a 1–5 Likert scale.

Additionally, their subjective feedback on the user acceptance for each instance (complexity/frequency combination) based on their ability to understand and utilize the input. As expected, the user acceptance was dependent to the complexity and frequency, rendering only 25 % of the visual signals as acceptable by the users (Fig. 3). It was also evident that complexity was easier to compensate for by the users, while the frequency (defined also as speed at which the information was presented) was harder to follow.

The aim of the last session was to observe how such approach could be designed to optimally present the information to the users while not overloading them with information. It served as a first indicator for the potential solution to managing the extraneous cognitive load. One of the three visual streams as active for 50 % of the total time, while the other two for 37 and 38 %, respectively. Information from as least two streams was concurrently present for 31 % of the time while all three streams overlapped 8 times (one for a quite significant amount of time), accounting for 8 % of the session duration (Fig. 4).

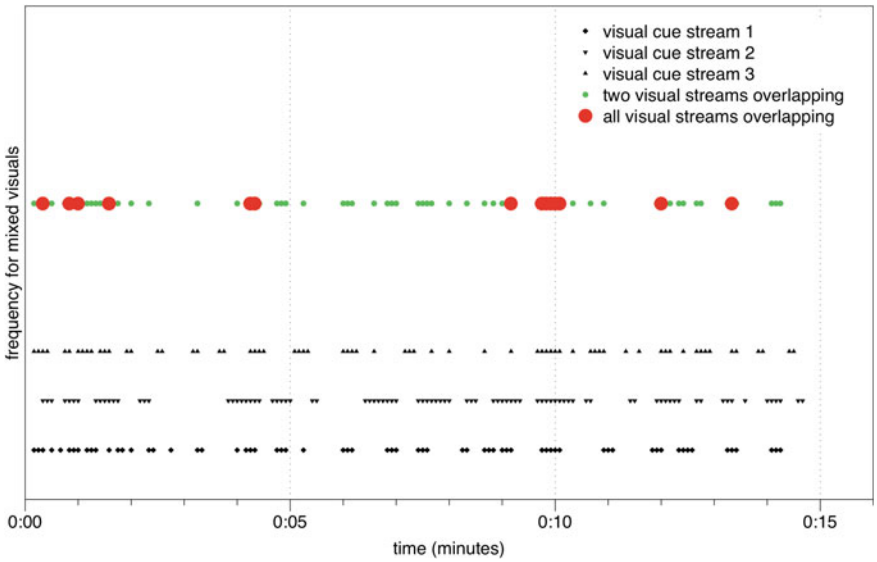


Fig. 4 The experiment location set up

4 Conclusion

The participant feedback, along with the session logs were analyzed for extraction of the findings from the subjective user feedback as well verification by the log data. It was clearly shown that a participant engaged in high-level complex interaction with another human, has very limited attention span to visual stimuli, even when that is purposed to assist them for the interaction. The need for post-processed information from infrequent high impact semantic visual notification was also clear. Additionally, focused feedback on one aspect of training was preferred to the fused approach that is also used on real life tutoring, for real time visual feedback, although that view was reversed for summative feedback after session, when the participants may reflect on their activity.

Further work on this subject is to examine the dynamics of the cognitive load on the participants under the conditions examined in this work based on the relevant related works [6]. This analysis is expected to provide insight on how the cognitive load is managed in order to optimize learning [7, 8].

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References

1. Nguyen, F., Clark, R.C.: Efficiency in e-learning: proven instructional methods for faster, better, online learning. Learning Solutions (2005)
2. Oviatt, S.: Human-centered design meets cognitive load theory: designing interfaces that help people think. In: Proceedings of the 14th Annual ACM International Conference on Multimedia, pp. 871–880 (2006)
3. Hollan, J., Hutchins, E., Kirsh, D.: Distributed cognition: toward a new foundation for human-computer interaction research. ACM Trans. Comput.-Hum. Interact. (TOCHI). **7**(2), 174–196 (2000)
4. Hollender, N., Hofmann, C., Deneke, M., Schmitz, B.: Integrating cognitive load theory and concepts of human-computer interaction. Comput. Hum. Behav. **26**(6), 1278–1288 (2010)
5. Feinberg, S., Murphy, M.:Applying cognitive load theory to the design of web-based instruction. In: Proceedings of the 18th annual ACM International Conference on Computer Documentation: Technology & Teamwork, pp. 353–360 (2000)
6. Sawicka, A.: Dynamics of cognitive load theory: a model-based approach. Comput. Hum. Behav. **24**(3), 1041–1066 (2008)
7. Bannert, M.: Managing cognitive load: recent trends in cognitive load theory. Learn. Instr. **12** (1), 139–146 (2002)
8. Wouters, P., Paas, F., van Merrienboer, J.J.G.: How to optimize learning from animated models: a review of guidelines based on cognitive load. Rev. Educ. Res. **78**(3), 645–675 (2008)

Virtual Reality Museum of Consumer Technologies

Avinash Subramanian, Jaclyn Barnes, Naveena Vemulapalli and Sumeet Chhawri

Abstract Given the rapid pace of technical development in the past several decades, many people have fond memories of using devices that are no longer common. We built a prototype of a virtual museum of consumer technologies to explore this with the intention of prompting memories of using past tech in the visitors. The prototype was created using the Janus VR browser and evaluated on a 2D display by 7 young adult users. It successfully prompted memories in all of the evaluators and all users rated the pleasure of touring the museum neutral or better. Future work involves making a more comprehensive museum and exploring better ways to utilize virtual reality for more engaging experiences.

Keywords Museums · Virtual reality · User needs

1 Introduction

Museums are important sources for presenting information about the past. However, these museums have some limitations like time, space, and the modes of interaction [1]. Moreover, most museums do not have the space and resources to exhibit all of their collections and also some objects are so fragile that the museum curators hesitate to make them available to public [2]. Due to the increasing use of computer and the advanced technologies, virtual reality museums or digital

A. Subramanian (✉) · J. Barnes · N. Vemulapalli · S. Chhawri
Michigan Technological University, 1400 Townsend Drive, Houghton, MI 49931-1295, USA
e-mail: avsubram@mtu.edu

J. Barnes
e-mail: jaclynb@mtu.edu

N. Vemulapalli
e-mail: nvemulap@mtu.edu

S. Chhawri
e-mail: schhawri@mtu.edu

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museums are becoming a good alternative to the physical museums. They allow all the users to interact with 3D models of objects in different ways [3].

Taking all these reasons into consideration, we have created a virtual reality museum that covers some of the recent history of technology. Our virtual reality museum consists of displays that are similar to those in physical museums [2, 4]. We focused mainly on three main categories of technologies that are used by people in daily life during approximately the last three decades: telephones, personal computers, and office equipment.

The main goal of this project is to trigger nostalgia in people who experience this virtual reality museum and have used some of the objects represented in the past. Our hypothesis is threefold:

- Touring the museum will be sufficient to prompt users' memories of past interactions with the devices shown.
- Both the experience of viewing the museum and the memories it triggers will be mostly pleasant.
- There will be some variance in the pleasure of the memories in accord with emotion regulation theory [5].

2 Background and Related Research

From large national museums with vast collections to tiny local historical societies, historical museums serve as a form of institutional and collective memory maintaining, preserving, and interpreting history and culture [6]. Our understanding of current circumstances and events is shaped by our knowledge of the past. That knowledge however is quite fragile and subject to distortion. Individual memory lacks the context and multiple perspectives that can be provided in a museum or by other forms of collective memory.

Museums, as can well be expected, are not a perfect solution. There are a variety of challenges. First, there is the difficulty of appropriate curation. While we make no pretense of addressing the thorny social issues of adequately and fairly represented complex events of the past, professionals who do have raised the concern that museums often lack necessary artifacts to illuminate the stories and experiences of minorities and others whose possessions never made their way to a museum's collection [6, 7]. Second, many artifacts are fragile and degrade with the everyday exposure that comes from being in a exhibit. Both the danger of damaging the objects and the cost of maintaining them can be prohibitive [7]. Next, space can be a significant challenge for museums, which often can only afford to display a fraction of their collections at any one time [7].

Virtual reality has been used to create museums and exhibits, to preserve artifacts, and to make them more accessible. Virtual reality has a number of advantages over traditional physical museums. For one, virtual models can be used to supplement physical collections when suitable physical object are not available.

A virtual museum also takes up far less physical space than a traditional museum and, depending on the implementation, can be portable or accessible from geographically distant locations. This presents a wide range of possibilities for traveling museums and displaying a larger portion of a collection. Finally, digitizing fragile artifacts allows them to be displayed virtually without risk of physical damage and can make them more accessible to general museum patrons [2].

Current work on virtual museums and similar technology often focuses on digitizing the collections of large museums around the world and sharing these digitized models. Other work is being done to preserve virtual models of archaeological digs, where the very act of collecting the artifacts destroys the scene. Existing projects include SCULPTEUR [8], Virtual Dig [2], and 3D Murale [9].

Our museum focuses on the history of consumer technologies, by which we mean technologies used by individuals and businesses as opposed to industrial, military, or scientific endeavors (though, there is inevitably some overlap). One of the characteristic aspects of the history of technology is the pace of change. In the span of a decade or two, new innovations and applications radically alter the use of consumer technologies. At the same time, many people have strong emotional ties to the technologies they use. The programs and devices present an interesting opportunity for historical preservation.

3 User Needs Analysis

Our target users are young adult and middle aged adult English speakers. This broad category was chosen because we deemed this demographic likely to have significant memories of consumer technology of the past 30 years or so. The language restriction was necessary as a significant portion of the information in our museum is conveyed via text or speech.

Informal interviews were conducted discussing the possibilities of a virtual reality museum and well-remembered technologies. Four young adults were interviewed, two American females and two Indian males. Strong preference for designing the virtual museum to resemble a physical museum was expressed, though asking whether they would prefer the exhibits be organized by era or technology produced divided opinions. One person requested hyper-realism to the point that reality and virtual reality were difficult to distinguish. The most common group of technologies listed as remembered and missed were entertainment devices, such as the Sony Walkman® or Game Boy™ Color.

Two middle aged American adults were also interviewed. We found there was a great deal of potential for nostalgia with this group as they had seen more of the rapid history of technological innovation and seemed intrigued by the prospect of being able to revisit these devices in a virtual reality museum. One suggested having the museum give a guided audio-visual tour of itself. The other was more interested in having an augmented reality museum rather than a pure virtual reality experience. Interestingly, as with young adults, it was entertainment technologies

that had some of the strongest sentimental appeal. None of those interviewed were familiar with the idea of 3D browsing.

Overall, the user needs analysis suggested that a virtual reality museum of technology was likely to be interesting to users and had the potential to trigger memories as desired. It also pointed toward designing a virtual reality museum to mimic the structure of a physical museum for familiarity.

4 Alternative Analysis

Three mediums for showcasing the history of technology were considered in the initial stages of the development:

- Website
- Mobile application
- Virtual reality and head mounted display

Our first inclination was to create a website. However, even a cursory web search quickly shows that a plethora of such sites already exist. Second, we considered developing an application on the Android or iOS platform for hand-held devices. The limitation of this was the smaller sizes of the hand-held devices and the potential that such an application would be less engaging than our third option, virtual reality via a head mounted display. With its potential for immersive and engaging interactions, virtual reality was a natural choice.

5 System Design

For any virtual reality system, its design plays a pivotal role in fulfilling the desired user experience demanded by the context. Our design was centered around two aspects: first, to maintain the realistic nature of any museum by building a room based traversal inside and second, to enhance the museum with virtual reality elements such as 3D models and audio descriptions [10]. The system comprises of four basic components: the JanusVR browser, 3-dimensional models, audio, and image galleries.

5.1 JanusVR 3-Dimensional Browser

JanusVR (http://www.janusvr.com/) is a 3-dimensional virtual reality browser developed by James McCrae. It changes the traditional scenario of viewing web pages on two dimensional monitors. Virtual reality has a lot of potential in web

technology in the future with the advent of Oculus Rift and similar HMDs [11]. JanusVR is built to work with Oculus Rift. In this browser, every web page is represented as a room with a door and to visit the webpage, users enter through the door rather than just clicking on it. The contents of the web page appear in three dimensions and supports the viewing with the Oculus Rift head mounted display. A defined set of syntax and semantics exists to build web pages which can be viewed in the JanusVR browser. The room to the web page can be chosen from a set of built-in templates or the user can define their own dimensions and create their own rooms. Contents like images, audio, video, text, objects, etc. can be added to the room as assets and various parameters like the speed of traversal, gravity, light, etc. can be controlled through the room by modifying room parameters.

5.2 Dimensional Models

In our system, we used.obj 3D models to display various technology exhibits as it is the only format supported by JanusVR. Most of the models use mtl files to apply lighting, shadows, detailing to the objects and some of them use multiple image textures to make them more realistic. Our museum prototype has seven models distributed among three exhibit rooms.

In our museum, each model was given a description which was placed on a plank next to it as is common in physical museums. In addition to including the standard factual information, we attempted to word the descriptions in such a way that the users were reminded of instances where they would have used the particular or a similar technology, thereby attempting to make them nostalgic when they see the model. When people are provided with content which triggers positive nostalgia, they tend to maintain that throughout the system [12]. The 3D models were placed in the middle of each room in order to give the user enough space to maneuver around the model without obstructing any views.

5.3 Audio

Audio was used in a number places throughout the museum with the intention of enriching the experience. Upon first entering the museum, a female synthetic voice reads a welcome message. At other points, entering a room or standing near a model triggers sound effects characteristic of the technology being viewed, such as the mechanical beeping of a modem dialing near the fax machine model or the boot up tones of an older Windows desktop. Having audio embedded acts as a tour guide to the museum and the user is more focused and informed about the exhibits [13].

5.4 Image Galleries

The sidewalls of each room were made to resemble a photo gallery containing displays related to the corresponding section of technology. Every image was displayed with frames in order to make them realistic. The back wall of every room contained a general description which introduces the user to what they are about to view inside the room.

5.5 System Flow

The system block diagram of the virtual museum was as shown in Fig. 1. The first phase of the system is the interaction of the user with the Oculus. This allows the user to explore the virtual museum. Once the user reaches the virtual museum, the models, images, text and audio accompanying the models is used to induce memories.

These experiences lead towards the user experience, specifically memory induction and finally the flow reaches the exit survey. The exit survey provides insight into the experience of the user and validates memory induction in users.

5.6 Virtual Reality Museum of Technology Layout

The layout of our museum is shown in Fig. 2. It has a total of four rooms—one for each section of technology covered (computers, telephones, and office equipment) and a main room which serves as the lobby to the museum. All the rooms in the museum have open ceilings. The main reason for this was to induce mood into the users as they step into the virtual museum. Having a sky filled with clouds generally induces memory in people [14]. The main room museum entrance is controlled by a single door which the user enters to step into the virtual museum. As they enter this

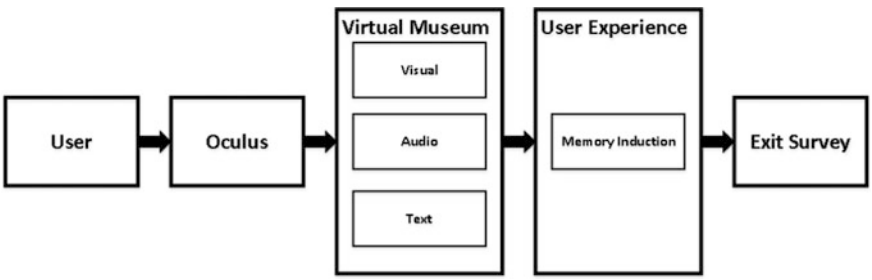


Fig. 1 System flow diagram for the virtual museum of consumer technologies

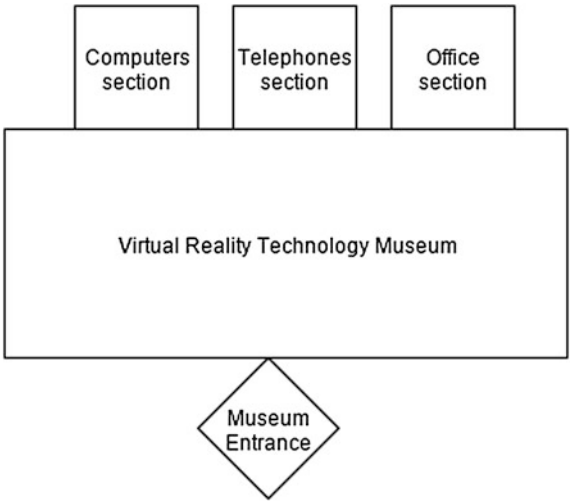


Fig. 2 Virtual museum of consumer technologies layout

room, an audio clip recorded using text-to-speech software welcomes them to the museum and guides the user of what the museum is made up of and gives directions which would help the user to traverse through the museum. A written description is also placed in the center of the room for the same purpose. The main room contains doors to the other rooms in the museums. The computers section is placed in the left, the telephones section in the middle, and the office equipment room is to the right. The user then moves ahead to view the exhibits set up in these rooms one after another.

The computers section room has two 3D models—a Bondwell personal computer on the left and an Apple iMac desktop on the right. The walls show several models of personal computers which have been in use over the last three decades like the IBM machines, mainframe desktops, and the evolution of the Windows operating system over the years. As the user enters the room, they are greeted with the audio of a Windows start up sound and when they get closer to the iMac model, the Apple start up sound is played.

The telephones exhibit contains three models—an Apple iPhone, an old cellular phone, and a cordless phone. The iPhone and the cordless phones have their trademark ringtones embedded to play when a user approaches. The walls show the evolution of mobile phones over the years and how the cellular technology has grown from large dial phones to the latest bendable smartphones.

The office equipment room contains two models: a fax machine and a typewriter embedded with sounds that are usually heard when they are in use. The walls show a variety of technology generally used in offices like the copy machines, printers, and calculators (Fig. 3).

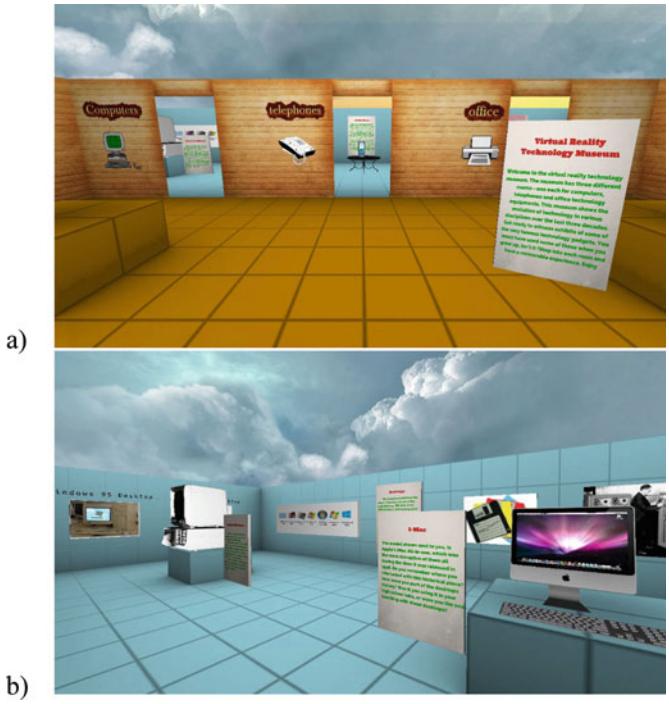


Fig. 3 **a** Welcome room 2D view; **b** computer technologies section

6 Evaluation

We evaluated our system during a demonstration session in a graduate level computer science course. Due to technical difficulties, the participants were unable to view the museum using a head mounted display. Instead, they experienced an unrelated demo of the Oculus Rift to get a feel for virtual reality and then viewed the museum on a standard 2D monitor. After touring the museum, they were asked to fill out a short survey. As participants were going through the demonstration and following, there was an ongoing, unstructured discussion and critique of the system.

There were 7 respondents to the survey, but not all participants responded to all questions. To the question "Did you enjoy the museum?", all participants rated the experience as neutral or higher on a 5 point Likert-type scale ranging from 0 *Not at all* to 4 *Very much*. All respondents indicated that they recalled using some of the displayed devices as they toured the museum, showing that we were successfully able to prompt memories. When asked "Which technologies do you remember using?", the most common answer was cordless phones with 5 people remembering using them, followed by Windows desktops with 4. Fax machines and iMacs were listed least with only one response each. Most people remembered using the technologies they listed remembering at home (6) and school (4).

We also asked about specific memories to help address the second and third portions of our hypothesis. There were only 6 complete responses to this section of the questionnaire. Half rated their memory as neutral (a 2 on a 5 point Likert-type question from 0 to 4) and half rated their memory positively (one response of a 3 and two 4 s, the highest rating on our scale).

7 Discussion

Based on the answers provided to the questionnaire, we conclude that hypothesis 1 was supported, touring the museum was sufficient to trigger memories. It is of course possible that asking about memory in the questionnaire increased or created this effect, but we attempted to avoid this by framing the question to apply only to memories experienced while touring the museum. Hypothesis 2 was not strictly supported. While no one rated either touring the museum or the memories it prompted negatively, many did rate either or both as neutral. Hypothesis 3 was somewhat supported as there was variation in both the ratings of enjoyment of the museum and pleasure of the memories, however, as previously mentioned no one rated either negatively.

All of these conclusions are of limited validity because of the small sample size of our evaluation, because users were not experiencing the museum in virtual reality as intended, and because our evaluation did not take place under normal circumstances for viewing a museum. Our evaluation occurred during a class with a number of people and a single viewing station for each part of the demonstration, which may have influenced people to proceed through the museum rapidly.

7.1 User Feedback

Directly contrary to what was suggested by our user needs analysis, several of the participants during the demo suggested that they would prefer more game-like interactions rather than traditional museum interactions. Suggestions included allowing the users to fly, “clickable” displays, more fanciful models, and requiring users to interact with the displays, i.e., pick up a model telephone to make it stop ringing.

While it was not stated directly by any of our participants, it was noticeable that many users did not stop to read the text descriptions included with the displays. Whether this was due to time constraints or lack of interest cannot be established from our work. However, it might be worthwhile to experiment with other ways of conveying important facts more rapidly without requiring reading.

Other useful suggestions included adding a thumbnail map to the display as users became disoriented quickly despite the relatively simple layout of our environment. Improving the stylistic elements of the exhibits was also suggested such as

having the decor of a room change to characterize styles common at the time the model being viewed was used. Gathering more data about the demographics of users in the survey was also suggested to allow for customized displays in the future.

7.2 Limitations

Our virtual museum has a number of limitations:

- Intrusive and cumbersome to use Oculus Rift: the Oculus head mounted display is intrusive to the user compared to the alternative designs of a web or smartphone application. It is cumbersome for first time users and those who wear glasses.
- Low fidelity to reality: As the consumer grade virtual reality devices are still quite a recent development, the technology is not yet mature. In particular, the fidelity to reality achieved is fairly low.
- Limited number of 3D models: The museum prototype we developed has only 7 models. This is tiny percentage of the technologies actually used during the timeframe we attempted to cover. While it is possible to create or buy more models, we were limited by time, file format, and budget constraints.
- Simulator sickness: Some users experience simulator sickness when interacting with virtual reality which makes the museum effectively inaccessible or at least quite uncomfortable to them.
- Passive System: The user was limited to viewing the museum as an observer. No user input or adaptive output was developed or utilized in this prototype system.

7.3 Adaptations

We made a number of adaptations to our system to mitigate the effects of the identified limitations.

- Images, Audio, & Text: As the 3D models had low fidelity compared to physical systems, they were supplemented with photographs, audio, and text descriptions. The image galleries on the exhibit walls provided supplementary material and detailed visuals. The audio clips, as explained in prior sections, included specific sounds characteristic of the models. Text included references to the model, its usage and history, and similar devices.
- Categorization of Models: We attempted to work around our limited number of models by organizing them in meaningful categories rather than by time period or some other method.

- Exit Survey: To gather user input without encountering the challenges of providing an input method suitable for virtual reality, an exit survey was created in Google Forms and completed by users after exploring the museum.

8 Future Work

The most obvious next step would be to expand the collection of 3D models and make a more complete museum. However, there are plenty of other enhancements possible. Our prototype does not take full advantage of the flexibility of virtual reality. It would be worthwhile to make the exhibits more interactive, using large scale models of internal components, visualizing invisible processes, and so forth. While our initial user analysis suggested users desired interacting with the virtual museum the same way they would a physical museum, the evaluation suggested people may prefer to have less traditional interactions including flying avatars, breaking walls, and interacting with objects. It would also seem wise to experiment with utilizing less text-heavy exhibits than in our initial design as users in the demo tended to ignore the descriptions we included. Improving the visual design and aesthetics of the museum and displays would also be a potentially valuable improvement.

9 Conclusion

The idea of a virtual museum of technology has a great deal of potential, particularly among the young adult demographic with whom we evaluated our system. Virtual reality has advantages over physical museums in a number of areas and, despite it's accompanying limitations, is still sufficient to prompt memories and emotional connections in the viewers. Any number of questions remain to be explored about how best to design virtual museums. Particularly interesting avenues for future research would be how to allow for user interaction both with the displays and with other users and how closely virtual museums need to align with traditional museum paradigms.

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References

1. Pan, Z., Chen, W., Zhang, M., Liu, J., Gangshan, W.: Virtual reality in the digital Olympic museum. IEEE Comput. Graph. Appl. **5**, 91–95 (2009)
2. Wojciechowski, R., Walczak, K., White, M., Cellary, W.: Building virtual and augmented reality museum exhibitions. In: Proceedings of the Ninth International Conference on 3D Web Technology. ACM, pp. 135–144 (2004)

3. Riva, G., Mantovani, F., Capideville, C.S., Preziosa, A., Morganti, F., Villani, D., Gaggioli, A., Botella, C., Alcañiz, M.: Affective interactions using virtual reality: the link between presence and emotions. CyberPsychol. Behav. **10**(1), 45–56 (2007)
4. Parsons, T.D., Rizzo, A.A.: Affective outcomes of virtual reality exposure therapy for anxiety and specific phobias: a meta-analysis. J. Behav. Ther. Exp. Psychiatry **39**(3), 250–261 (2008)
5. Gross, J., Thompson, R.: Handbook of Emotion Regulation. Guilford Press, New York NY, Chapter Emotion regulation: Conceptual foundations (in press)
6. Macdonald, S.: A Companion to Museum Studies, vol. 39. Wiley, NY (2011)
7. Tisdale, R.: Do history museums still need objects? Hist. News Summer **2011**, 19–24 (2011)
8. Goodall, S., Lewis, P.H., Martinez, K., Sinclair, P.A.S., Giorgini, F., Addis, M.J., Boniface, M.J., Lahanier, C., Stevenson, J.: SCULPTEUR: multimedia retrieval for museums. In: Image and Video Retrieval. Springer, Berlin, pp. 638–646 (2004)
9. Grabczewski, E. Cosmas, J., Van Santen, P., Green, D., Itagaki, T., Weimer, F.: 3D MURALE: multimedia database system architecture. In: Proceedings of the 2001 Conference on Virtual Reality, Archeology, and Cultural Heritage. ACM, pp. 315–322 (2001)
10. Yavelow, C.: Macworld Music and Sound Bible. IDG Books Worldwide, Inc (1991)
11. Coyne, R.: Heidegger and virtual reality: the implications of Heidegger's thinking for computer representations. Leonardo, 65–73 (1994)
12. Wildschut, T., Sedikides, C., Arndt, J., Routledge, C.: Nostalgia: content, triggers, functions. J. Pers. Soc. Psychol. **91**(5), 975–993 (2006)
13. Bederson, B.B.: Audio augmented reality: a prototype automated tour guide. In: Conference Companion on Human factors in Computing Systems. ACM, pp. 210–211 (1995)
14. Parrott, W.G., Sabini, J.: Mood and memory under natural conditions: evidence for mood incongruent recall. J. Pers. Soc. Psychol. **59**(2), 321 (1990)

A Study on Communication Activity and Social Skills of Nursing Organization

Yuki Mizuno, Yasuyuki Yamada, Yasuyuki Hochi, Hideko Takahashi, Naoto Shoji, Hideko Aida, Aya Okada and Motoki Mizuno

Abstract In this study, a quantitative rating of the communication using the device (behavior sensor) which enabled the measurement of communication and social skills in the hospital, was implemented. The subjects of this study were two hospitals. The measurement of communication used the behavior sensor which electronic badges were capable of measuring social signals, it was measured for two weeks. The result of the communication activity between staffs was 58.0 min per day. In comparison with the communication time, male nurses were more than one and a half times larger than females ($p < 0.001$). Particularly, male nurses tended to regard cooperation as more nurses regardless of job status or sex. According to the result of social skills, more experienced nurses had high skill. In the GP analysis of the communication time, the skill of emotion processing of an upper rank group was higher than a lower rank group ($p < 0.1$). These observations led to the speculation that a male nurse made more communication in the workplace, and cooperated with more nurses. In addition, the nurse who had high communication skills tended to have high expression skill of one's feelings.

Keywords Communication activity · Nursing organization · Social skills · Behavior sensor · Good-poor analysis (GP analysis)

Y. Mizuno (✉)
Center of Liberal Arts, Toyo Gakuen University, Tokyo, Japan
e-mail: yuki.mizuno@tyg.jp

Y. Yamada · H. Takahashi · N. Shoji · M. Mizuno
Graduate School of Health and Sports Science, Juntendo University, Chiba, Japan

Y. Hochi
Faculty of Health and Welfare Human Service, St. Catherine University, Ehime, Japan

H. Aida
Koshigaya Hospital, Juntendo University, Saitama, Japan

A. Okada
Nerima Hospital, Juntendo University, Tokyo, Japan

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1 Introduction

In the recent hospital organization, a form of the team medical care is taken. In a work system accomplishing duties as a team, the communication between health-care workers plays an extremely important role. If an effective transmission system based on good human relations is not formed, it is extremely difficult to understand about the medical security and to joint ownership of objectives. It is necessary to examine a problem that the communication for the achievement of the medical security by the viewpoint of the human relations in the frame which the team based on the above [1].

In the nursing scene, there are many hospital organizations adopting a method to provide nursing as a team. However, the study of the teamwork in the nursing scene was in a developing stage, and the viewpoint of the teamwork process that supported communication such as the human relations of the job to support communication and the viewpoint of the interaction process, have passed undetected in the past study. In recent years, the lack of communication skills; such as an improper cooperation between staffs and sectionalism strength between sections, is regarded as a problem of human error [2]. Then, it is necessary that there is two-way communication in the workspace.

In this study, a quantitative rating of the communication using the device (behavior sensor) which enabled the measurement of the communication in the university hospital was implemented. In addition, the social skills makes the interpersonal relationships smooth, the relation with the communication of nursing organization and the social skills were evaluated.

2 Methods

2.1 Attribute

The subjects of this study were two university hospitals; hospital A was a psychiatry ward that belongs to many male nurses, and hospital B was a maternity ward that belongs to only female nurses. The object nurses of hospital A were 16 males and 14 females, and the hospital B were 24 females (Table 1). Fifty-four participants consisted of eight administrative nurses including one senior nursing officer, one nursing divisional managers and three nursing chief managers and forty-eight staff nurses. Moreover, they were full time workers.

Table 1 Attribute for this study in two hospitals

Attribute for this study	Hospital A	Hospital B
Hospital ward	A psychiatry ward	A maternity ward
Object number	30 nurses (male = 16, female = 14)	24 nurses (female = 24)
Job status	Administrative nurses = 5 Staff nurses = 25	Administrative nurses = 3 Staff nurses = 21
Mean age (mean ± SD)	34.9 ± 6.87 years old (m = 34.2 ± 4.59, f = 35.7 ± 8.82)	31.2 ± 6.26 years old
Mean year of experience (mean ± SD)	11.09 ± 7.28 years (m = 9.5 ± 4.70, f = 12.9 ± 9.26)	8.0 ± 6.23 years

2.2 Measures

1. Communication Activity
   Measurement of the communication activity at nursing organizations was measured with electronic badges [3] (wearable sensing devices) developed by MIT and applied by Hitachi High-Technologies Corporation in Japan. Electronic badges capable of detecting face-to-face inter-actions, conversations, body movement and physical proximity introduced in order to measure the organizational communication.
   The object nurses wore electronic badges for measuring the communication time, including formal and informal scenes (e.g. nursing station, locker rooms and dining rooms) during working hours as the communication channels and social signal-ling behaviour. In this study, measuring period of the communication activity was two weeks, and we analyzed human relations and communication networks between nurses from the frequency of communication by calculating total time of communication.
2. Social Skills
   The evaluation of social skills was used Social skills scale (KiSS-18) [4, 5] which Kikuchi was developed. KiSS-18 was based on the list of social skills for youths (Goldstein, Sprafkin, Gershaw and Klein 1980), and it is widely used as a standard to measure the social skills that is required for smooth interpersonal relations generally.
   Social skills scale were consist of 18 items, based on scale of 1–5 (1 = strongly disagree, 5 = strongly agree). They grouped into six categories; (1) beginning social skills (starting a conversation, asking questions or the self-introduction), (2) advanced social skills (standing up for a friend, giving instructions or apologizing), (3) dealing with feelings (notice their feelings, expressing their feelings or handling the fear), (4) alternatives to aggression (helping others, settlement or control their own), (5) dealing with stress (depending on the difficult conversation, treatment failure or processing the blame), and (6) planning skills (setting a goal, knowing their abilities or making a decision).

3. Analysis
   For two weeks, the time for face-to-face communication was recorded from the start of work to the end of work (including the break). After having added up communication time of two weeks, we calculated face-to-face communication time per day and made some figures of network by communication time (>30, >60, >90, >120, >180 min, etc.).
   Social skills added up the six categories and total counts, and compared them with sex, experience years and communication time. The communication time was analyzed GP analysis (Good-Poor analysis, an upper rank group (good): >mean + 0.5 SD, a lower rank group (poor): <mean-0.5 SD), and the social skills performed examination by statistical processing to the difference between an upper rank group and a lower rank group in communication time.

3 Results

3.1 Communication Activity

The result of the communication activity between staffs is shown in Table 2. The mean time (minutes) of face-to-face communication was 58.0 min per day (hospital A: 78.0 min, hospital B: 32.0 min), it showed a significant difference between hospitals ($p < 0.001$). In comparison with the communication time, male nurses were more than one and a half times larger than females (male: 81.1 min, female: 48.1 min, $p < 0.001$). In comparison with the years of experience, more experienced nurses tended to make more communication between staffs.

The total amount time (minutes) at which the nurses of two hospitals spent as face-to-face communication was calculated at 30, 90 and 180 min interval units per a day (Figs. 1 and 2). Communication networks have been getting tight more and more individually, according to time axes from 30, 90 min to 180 min [6]. In addition, with progress of the time, interpersonal connection became clearer. As

Table 2 The mean time of face-to-face communication per one day

		The time of face-to-face communication (min)	
Mean time of all subject		58.0	(Male = 81.1, female = 72.2)
Hospital	Hospital A	79.6***	
	Hospital B	32.0***	
Sex	Male	81.1***	
	Female	48.1***	
Experience	10 and over	66.4*	
	5–9 years	50.4*	
	5 and less	52.1*,†	

***$p < 0.001$, **$p < 0.01$, *$p < 0.05$, †$p < 0.1$



Fig. 1 The communication network figures per one day at hospital A, *m* male nurse, *f* female nurse, *a colored circle* the administrative nurse, *a circle of the dotted line* the key person got the cooperation between nurses



Fig. 2 The communication network figures per one day at hospital B

time goes by, a communication network became clarified. Besides, the key person in nursing organization became clear at the time unit at of 180 min the most. The key persons in this study were two staff nurses and an administrative nurse both hospitals (right side of Figs. 1 and 2). Particularly, in hospital A, male nurses tended to regard cooperation as more nurses regardless of job status or sex.

3.2 Social Skills

The result of social skills is shown in Table 3. There is no significant variation with category in the score of all subjects, and there was a correlation each category ($p < 0.01$). The significant difference was not between sex and hospitals, on the other hand, the difference has been confirmed between the years of experience. According to the years of experience, unskilled nurses who were less than four years were the highest in the value of beginning skill ($p < 0.1$), and skilled nurses were the highest in the value of another skills and total counts ($p < 0.1$).

Basic statistic of communication time was mean time; 56.9 min, standard deviation; 29.78 min, skewness; −0.956, and kurtosis; 0.285. The distribution of that data had a shorter hemline than normal distribution, and became the form that right and left were equal. This data was divided into a group of mean ±0.5 SD. 71.8 min and over of communication time was an upper rank group (17 nurses, 31.5 % of total), and a lower rank group (22 nurses, 40.7 % of total).

In the GP analysis of the communication time, the skill of emotion processing of an upper-group was higher than a lower rank group ($p < 0.1$) (Table 4).

Table 3 The mean score of social skills scale (KiSS-18)

		Beginning	Advanced	Feeling	Alternative	Stress	Planning	Total
Mean score of all subjects		9.5	10.6	9.3	9.6	9.8	9.9	58.6
Hospital	Hospital A	9.2	10.6	9.5	9.6	9.7	10.1	58.7
	Hospital B	9.8	10.6	9.1	9.5	9.8	9.8	58.5
Sex	Male	9.3	10.8	9.7	9.8	9.9	9.9	59.3
	Female	9.6	10.5	9.1	9.5	9.7	9.9	58.3
Experience	10 and over	$9.4^{\dagger}$	$11.2^{*,\dagger}$	9.8*	10.1*	$10.4^{*,\dagger}$	10.4*	$61.2^{*,\dagger}$
	5–9 years	$9.1^{*,\dagger}$	$10.1^{*,\dagger}$	8.6*	8.7*	$9.3^{*,\dagger}$	9.7*	$55.4^{*,\dagger}$
	4 and less	$10.3^{*,\dagger}$	$10.2^{\dagger}$	9.1	9.6	9.2*	9.3*	$57.6^{\dagger}$

$^{***}p < 0.001$, $^{**}p < 0.01$, $^{*}p < 0.05$, $^{\dagger}p < 0.1$

Table 4 The mean score of social skills scale (KiSS-18) by GP analysis

	Beginning	Advanced	Feeling	Alternative	Stress	Planning	Total
Upper rank group	9.3	10.8	9.6†	9.5	9.9	10.2	59.3
Lower rank group	9.8	10.4	8.8†	9.4	9.7	9.6	57.6

$^{***}p < 0.001$, $^{**}p < 0.01$, $^{*}p < 0.05$, $^{\dagger}p < 0.1$

4 Discussion

Comparing with the communication activity of two hospitals, the mean of the communication time in hospital A was higher than hospital B. So, members of the communication network were 26 nurses (>30 min) and 16 nurses (>180 min) both hospitals, there was no difference in the number of nurses as the figures of network showed. The key parsons who got the cooperation and connect the network were many staff nurses. It was considered that the communication time with medical staffs was longer than staff nurses, because the duties of administrative nurses were often deskwork such as administrative work and schedule management. The communication time of male nurses were larger than females, and male nurses took the cooperation with more nurses. It may have implications for how they spend informal as well as formal.

According to Social Skills, there was no difference between the sexes, although there was a difference between experience. The social skills is supported by experience that had the same result as previous research [7]. In addition, the nurses who had high communication skill tended to have high expression skill of one's feelings. It is considered that skilled nurses had been trained dealing with feelings such as self-control and expression of one's feelings. In late years, medical institutions which carries out assertion training to make appropriate self-expression increase. If expression skill of one's feelings is related to assertion, the introduction of this training may involve communication activity effectively. However, in Takahashi's study [8], it has reported that the communication time of the nurses who were high in an assertive score concentrated on moderately, and they took the communication efficiently and properly. Therefore, it is necessary to do a more targeted analysis that focused on connection of communication, self-expression type and so on.

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References

1. Robbins, S.P., Judge, T.A.: Essentials of Organizational Behavior. Prentice Hall, Englewood Cliffs (2012)
2. Oka, K.: A resilience analysis of a judicial precedent on a medical malpractice. IEICE Tech. Rep. **114**(67), 319–322 (2014)
3. Olguin-Olguin, D., Pentland, A.: Sensor-based organisational design and engineering. Int. J. Organ. Des. Eng. **1**, 69–97 (2010)
4. Kikuchi, K.: Research on Science of Compassion: Psychology and Skill Orienting to Social Behavior, Kawashima-Shoten (1988)
5. Kikuchi, K.: Shakaiteki-Sukiru-wo-hakaru-KiSS-18 Handbook. Kawashima-Shoten (2007)
6. Mizuno, M., Yamada, Y., Hochi, Y., Honda, R., Takahashi, H., Shoji, N., Aida, H., Okada, A., Mizuno, Y.: Behavioral sensor-based organizational design and management in Japan—from the perspectives of communication channel in nursing organization. In: Proceedings 19th Triennial Congress of the International Ergonomics Association. CD-ROM (2015)
7. Masuhara, K., Uchida, H., Emiko Tarui, E., Tsumoto, Y., Osada, K., Nagasawa, Y., Fukuma, M.: Development of nurses with nursing performance and social skills. Bull. Shimane Univ. Fac. Med. **30**, 51–57 (2007)
8. Takahashi, H., Mizuno, M., Yamada, Y., Hochi, Y., Shoji, N., Mizuno, Y., Honda, R.: Relationship between assertion types and communication networks of a nursing organization at university hospital. 2nd Congress, International Academy of Sportology, Program & Abstracts, p. 52 (2015)

Part X
Products and Value Networks in Management and Leadership

Internet Marketing Strategy for Furniture Industry: A Research Based Ergonomics Sofa

Suriatini Ismail, Anis Amira Abdul Rahman, Ahmad Rasdan Ismail, Khairul Azhar Mat Daud and Nik Zulkarnaen Khidzir

Abstract The objective of this paper is to reveal the awareness of ergonomics as part of internet based marketing strategy in furniture industry. Based on Actor Network Theory (ANT), this study believes that internet marketing is an object that links buyer and seller. Empirical study of previous practices has failed to indicate common use of ergonomics term in this research area of marketing strategy. Most of the marketing strategy literature in furniture industry has focused more on aesthetic than ergonomics issues. Therefore, this study utilized qualitative research to analyze the use of ergonomics term in the websites for marketing strategy. This study has identified 33 websites of furniture industry to address the issues using purposive sampling technique and content analysis. The finding shows the ergonomics term is not a common exposure in the websites of furniture industry. It confirms the lack of awareness about the utilization of ergonomics term in the companies' websites. This research recommends that future marketing strategy should highlight the ergonomics issues in the company's website in order to promote public health. Hence, this new knowledge suggests that the furniture industry should be more health conscious. Furthermore, future research can also focus on other tools of digital marketing strategy.

Keywords Furniture industry · Digital marketing strategy · Ergonomics sofa

S. Ismail (✉) · A.R. Ismail · K.A.M. Daud · N.Z. Khidzir
Faculty of Creative Technology, Universiti Malaysia Kelantan (UMK),
Locked Bag 01, 16300 Bachok, Kelantan, Malaysia
e-mail: suriatini@umk.edu.my

A.A.A. Rahman
Faculty of Entrepreneurship and Business, Universiti Malaysia Kelantan (UMK),
Locked Bag 01, 16300 Bachok, Kelantan, Malaysia

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1 Introduction

The objective of this paper is to reveal the awareness about public health in digital marketing strategy of furniture industry. Based on Actor Network Theory (ANT), this study believes that internet marketing is an object that links buyer and seller. Empirical study of previous practices has failed to indicate common use of ergonomics term in this research area of marketing strategy. Most of the marketing strategy literature in furniture industry has focused more on aesthetic than ergonomics issues. This paper argues that empirical study of previous practices has failed to indicate common use of ergonomics term in the research area of digital marketing strategy. This is based on the literature search run on the Web of Science database. A simple search using the terms "furniture" and "digital marketing" and "ergonomics" returned no results.

The paper addresses the following question:

- How extensive is the terms of ergonomics or health related being used in the websites of furniture industry?

The methodology of this study rests primarily on the review of literature that relates to marketing strategy and content analysis of websites in furniture industry in Malaysia and globally.

2 Literature Review

This section reviews the literature that relates to marketing strategy in furniture industry. Simple definitions of several important terms are included to give context of the paper. These refer to furniture, public health, sofa. Furniture refers to chairs, tables, beds, etc., that are used to make a room ready for use. Public health refers to the art and science dealing with the protection and improvement of community health by organized community effort and including preventive medicine and sanitary and social science. Meanwhile sofa is defined as a long upholstered seat usually with arms and a back and often convertible into a bed [1].

Referring to a scholarly definition, marketing is that function of the organisation that can keep in constant touch with the organisation's consumers, read their needs, develop products that meet these needs, and build a programme of communications to express the organisation's purposes [2]. Ultimately, the aim of any type of marketing is to keep customers and stimulate sales in the future.

Digital communication tools make it possible to connect and build long-term relationships with customers. Digital marketing helps to create consumer demand by using the power of the interconnected, interactive web. It enables the exchange of currency but, more than that, it enables the exchange of attention for value. This is referred to as the attention economy. Digital marketing is powerful in two fundamental ways. First, the audience can be segmented very precisely—even down to

factors like current location and recent brand interactions—which means that messages can (and must) be personalized and tailored specially for them. Marketing is about conversations and the Internet has become a hub of conversations. The connected nature of the Internet allows us to follow and track these conversations and provides entry points for all parties [3]. This is in line with Actor Network Theory (ANT) that leads to the connotation of internet marketing as object that links buyer and seller.

According to Constantinides [3] marketing as academic discipline and management activity has been the subject of substantial transformations during the last twenty years. Many scholars and practitioners agree that some of the old marketing tenets seem to lose ground while the popular in the 60s and 70s mass marketing approaches become less effective. Media proliferation, market globalization and the emergence of a new generation of Information and Communication Technologies—the Internet being the most prominent of them—are changing the marketing rules and market dynamics by weakening the corporate competitive position while presenting individuals with many new opportunities and empowerment.

There is continuously growing importance of digital marketing in the industrial sector which is regarded as being characterized by complex selling processes [4]. Farman [5] outlines 7 essential digital marketing strategy for furniture business as follows:

1. Competitor Research
   What Digital Marketing Strategy your Competition is using in your region? Research keywords users' type in the search engine to find furniture related products.
2. Create Responsive Web Design
   Make your website accessible on all devices like Android, iPhone, iPad. Users nowadays use internet with their mobile devices and having Responsive Web Design is inevitable.
3. Setup E-Commerce Solution
   Allow users to browse through your website to find new furniture designs and to purchase from your website. Create Shop front and e-commerce payment setup that will allow users to see and buy furniture. You might be offering special discount in specific days of the year or on certain furniture and programming all that at the backend would help automate all this process. Use Infusionsoft or similar other solution that provides all the features and flexibilities of what you want to choose.
4. Inbound Marketing: Be Found in Search Engines—Search Engine Optimization
   Search Engine Optimization: Be found in Search Engines. If users are searching internet and not finding your furniture products in search results, there's no need of moving forward. Increase your website search engine visibility so that Executives of Companies in your region can easily find your website. Appear in local listings by using Google Service or plugins available in WordPress and

similar other open source solutions. Read eBook: How to Maximize LinkedIn for your Business.

5. Fresh Content is King—Create Content
   Create content that addresses your Target Audience Concerns. Increasing visibility in search engine isn't possible without having quality content. Create Fresh Content in the form of images ad offering discount on purchase of furniture, Discount coupons, Image Gallery, Videos, and Blog Posts. Writing Fresh Content regularly and addressing your Target Audience concerns and educating them about the products and solutions you offer would work.
6. Pay-Per-Click Advertising
   You'd also be interested in promoting furniture designs for which you're offering huge discount or are introducing new furniture designs in the regional market. In either case, Display and Search Advertising would be a good way to spread your company's message and leaving digital footprints. One tip for you if you're considering using this option is separate display and search network campaigns. This will lower down your cost per click. Furthermore, starting Google Adwords campaign would also help you in choosing the keywords for organic search engine optimization campaign as you can use them in content writing.
7. Social Media Marketing
   Create LinkedIn Company Page, LinkedIn Profile, LinkedIn Groups, and optimize them so that your company, products and solutions would be appearing in search results. Read eBook: How to Maximize LinkedIn for your Business Instagram, Pinterest, Twitter Page, Google Plus, Facebook, YouTube are the places where you should engage your target audience. Use Google for Business and also share your company's physical location so that it's accessible in local search results.

2.1 Digital Marketing Strategy

Digital marketing strategy builds on and adapts the principles of traditional marketing, using the opportunities and challenges offered by the digital medium. It drives the creation of demand using the power of the Internet. User centric thinking is vital when looking at the building a successful digital marketing strategy [6].

Internet usage continues to explode across the world with digital becoming an increasingly important source of competitive advantage in marketing [7]. As illustrated in Fig. 1 company home page has been the most popular tool in use. Meanwhile mobile application was anticipated to dominate the marketing strategy

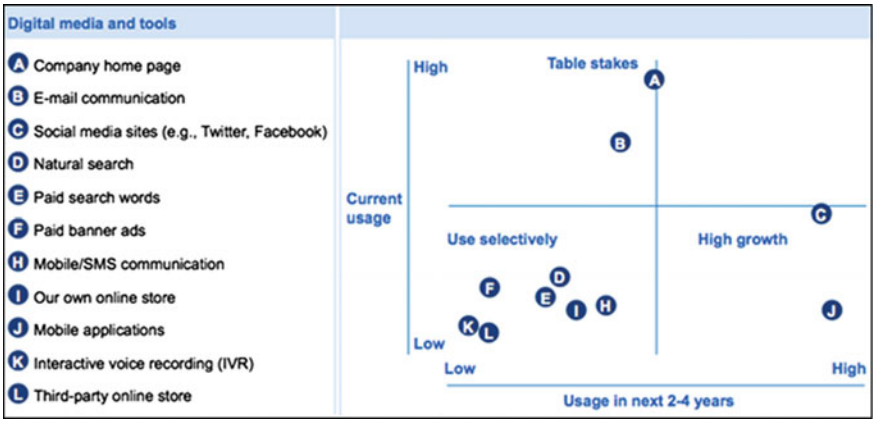


Fig. 1 Current usage and future usage matrix of digital marketing tools [7]

within these few years to come. In parallel to this, [3] highlights the increasing pressure on marketers to adjust their approaches in communicating and interacting with their customers in the evolving marketing ecosystem where technology plays an increasingly important role.

Constantinides [3] proposes two possible Social Media marketing strategies namely the passive approach focusing on utilizing the Social Media domain as source of customer voice and market intelligence and the active approach i.e. engaging the Social Media as direct marketing and PR channels, as channels of customer influence, as tools of personalizing products and last but not least develop them as platforms of co-operation and customer-generated innovation. Colbjornsen [8] states that the success of consumer technologies relies upon an alignment with particular social groups, and their perceptions of relevance and demand. Zenettia et al. [9] state that firms must consider the investments in various media channels simultaneously when they design multimedia campaigns.

2.2 Ergonomics

Meyer and Fourie [10] describe that ergonomics is a field of study that attempts to provide a perfect fit between individuals and their work environments. It can be applied to nearly every type of environment imaginable. Nature of office work has evolved into a highly collaborative and social activity requiring an integrated work

environment, therefore moving from a traditional "office ergonomic" approach (i.e. engineering and cognitive ergonomics) to a "holistic" approach. The "holistic" approach incorporates the physical (engineering ergonomics), mental (cognitive ergonomics) dimensions of a work environment, and formal and informal collaboration and interaction (social ergonomics) between individuals and their shared workspace.

Ergonomics is the involvement of utilizing proper posture and equipment for people who must usually sit or perform repetitive tasks for a long period. It is the science of the body in correlation to the workplace, and how various jobs can affect one's health. Comfort is not only important to help maintain stress levels, but it also minimizes impact on the joints and other parts of the body when sitting or when strained for several hours at once. Implementing ergonomics in an office environment helps to ensure the physical well-being as well as mental calmness of employees who must remain in one position for a long length of time. Using proper ergonomics can help to keep peoples' backs healthy, prevent problems like carpal tunnel syndrome, and promote healthier posture [11].

Fialho et al. [12] performed an ergonomic evaluation of industrial processes and products in Brazil. It is found that the upholstered sofas produced by industries, in general, fulfilled to the recommendations set out in the work in relation to the backrest height and useful seat depth. All the sofas, however, proved to be inadequate in relation to the seat height to the floor and the dimensions of the armrests. Regarding environmental aspects, it was observed that the activities in most jobs are performed under adverse conditions to the health and safety of workers and nonconformity with the limits set by Brazilian regulatory standard used in this work.

It is thus, paramount that public health is promoted simultaneously with any promotion of sofa that considers ergonomics elements. Ideally, all sofa available in the furniture industry should be a research based healthy sofa in order to ensure maximum public health.

3 Methodology

This paper adopts a qualitative research approach which is based on a purposive sampling of websites in furniture industry. Thirty three websites were analyzed. Thirteen were based in Malaysia while the rest were internationally based. These websites were utilized to perform a content analysis. The objective was to identify the use of terms that obviously relate to ergonomics or health.

4 Results and Discussions

The result of content analysis based on 33 websites of companies in furniture industry indicates that health is not of prime concern in Internet marketing. Tables 1 and 2 summarize the results of the content analysis of the webs. None of the 13 companies situated in Malaysia used the terms that relate to ergonomics or health in their websites. Nonetheless 7 out of 19 (37 %) internationally based companies show evidence of use. Generally, the finding shows that the ergonomics term is not a common exposure in the websites of furniture industry. Referring to [9], there are 4 consumer metrics namely advertising awareness, brand awareness, brand image, and brand consumption that should be given attention in a marketing strategy. Looking from the perspective of public health, this indicates that health is not a primae concern in the marketing strategy of furniture. However, the effectiveness of online advertising generally can be measured by impressions generated apart from number or percentage of click-throughs, or induced sales or conversion rates, the use of obvious terms that relate to ergonomics or health should give a difference to the marketing strategy in terms of impression of the product. This is particularly relevant in the case of a research based ergonomics sofa. Not only it may help in terms of impression of the product for business purposes, but also it is a simultaneous promotion of public health.

Table 1 Inclusion of ergonomics/health related terms in website of furniture industry in Malaysia

Company name	Website address	Inclusion of obvious ergonomics/health related terms
1. Delima Home	www.delimahome.com.my	No
2. LAZADA	www.Lazada.com.my	No
3. 12 Buy Furniture	www.12byfurnitureonline.com	No
4. MyFurnitureShop	www.myfurnitureshop.com.my	No
5. Lelong.my	www.lelong.com.my	No
6. Victoria Furniture Gallery	www.victoria.my	No
7. youbeli	www.youbeli.com	No
8. Harvey Norman	www.harveynorman.com.my	No
9. More Design Asia	www.moredesign.asia	No
10. Ideal Home Furniture	www.idealfurniture.com.my	No
11. CASA ITALY	www.casaitaly.com	No
12. FUTURE	www.futuresofa.com	No
13. Dynamic	www.dynamic-brand.com	No

Note IKEA is the number one furniture company in North European countries [8]

Table 2 Inclusion of ergonomics/health related terms in website of furniture outside Malaysia

Company	Website address	Geographical base/state/country	Inclusion of obvious ergonomics/health related terms
1. HOMEBASE	www.homebase.co.uk	UK	No
2. Snapdeal	www.snapdeal.com	India	No
3. O.co	www.overstock.com	Salt Lake City, Utah	No
4. Online Sofa Wholesale	www.onlinesofawholesale.com	Birmingham	No
5. Furniture Village	www.furniturevillage.co.uk	UK	No
6. dfs	dfs.co.uk	UK	No
7. graysonline.com	www.graysonline.com	Australia	No
8. Pepperfry	www.pepperfry.com	India	No
9. LEE Industries	www.leeindustries.com	Usa	Yes
10. Hem	hem.com	Europe	Yes
11. Vanguard Furniture	www.vanguardfurniture.com	US	Yes
12. FIRA (2015)	www.fira.co.uk	UK	Yes
13. The Center of Health Design	www.healthdesign.org	US	Yes
14. The Human Solution	www.thehumansolution.com	Texas	Yes
15. IKEA*	www.ikea.com	Korea	Yes
16. Furniture Row	www.furniturerow.com	US	No
17. SCS	www.scs.co.uk	Sunderland	No
18. ASHLEY FURNITURE	www.ashleyfurniture.com	California	No
19. LORENZO	www.lorenzo-international.com		No
20. ALIBABA.COM	www.alibaba.com		No

5 Conclusions

This paper aimed to reveal the use of ergonomics or health related terms in digital marketing strategy of furniture industry. The findings suggest there the use of these terms is not a common practice in the samples of the study. The research recommends that future marketing strategy should highlight the ergonomics issues in the company's website in order to promote public health apart from creating a difference in marketing strategy for furniture industry. This is particularly relevant to a research based ergonomics sofa. This new knowledge suggests that the furniture industry should be more health conscious. Furthermore, furniture industry can also focus on other tools of digital marketing strategy in order to be more competitive.

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References

1. http://www.merriam-webster.com/dictionary/. Accessed 10 Mar 2016
2. Philip, K., Sidney, J.: Levy broadening the concept of marketing. J. Mark. **33**(1), 10–15 (1969). doi:10.2307/1248740
3. Constantinides, E.: Foundations of social media marketing. Procedia Soc. Behav. Sc. **148** (2014), 40–57 (2014)
4. Järvinen, J., Karjaluoto, H.: The use of Web analytics for digital marketing performance measurement. Ind. Mark. Manage. **50**(2015), 117–127 (2015)
5. Farman, M.: 7 essential digital marketing strategies for your furniture business. https://www.linkedin.com/pulse/20140713141048-42454087-7-essential-digital-marketing-strategies-for-your-furniture-business (2014)
6. Stokes, R.: eMarketing: The Essential Guide to Marketing in a Digital World, 5th edn. Quirk eMarketing (Pty) Ltd. (2014)
7. Leeflang, P.S., Verhoef, P.C., Dahlström, P., Freundt, T.: Challenges and solutions for marketing in a digital era. Eur. Manag. J. **32**, 1–12 (2014)
8. Colbjornsen, T.: Digital divergence: analysing strategy, interpretation and controversy in the case of the introduction of an ebook reader technology. Inf. Commun. Soc. **18**(1), 32–47 (2015). doi:10.1080/1369118X.2014.924982
9. Zenettia, G., Bijmoltb, T.H.A., Leeflang, P.S.H., Klapper, D.: Search engine advertising effectiveness in a multimedia campaign. Int. J. Electron. Commer. **18**(3), 7–38 (2014). doi:10.2753/JEC1086-4415180301
10. Meyer, A., Fourie, I.: Collaborative information seeking environments benefiting from holistic ergonomics. Libr. Hi Tech **33**(3), 439–459. http://dx.doi.org/10.1108/LHT-06-2015-0062 (2015)
11. http://www.sofasandsectionals.com/healthy-furniture-through-ergonomics. Accessed 7 Dec 2015
12. Fialho, P.B., de Souza, A.P., Minette, L.J., de Castro Silva, J., de Oliveira, L.A.: Ergonomic evaluation of processes and products in the manufacture of upholstery. Work **41**(1), 1739–1742 (2012)

The Design Service as an Improvement Tool of the International Show of the Bobbin Lace from Peniche

Isabel Bieger, Cristina Carvalho and Gianni Montagna

Abstract The starting point is the increasing decline of the bobbin lace from Peniche—Portugal. A product that has been the financial support for many families and today it is only cherished as Peniche's people's identity. Between the former and the latter, there is no straightforward path. It was necessary an interventionist approach from the local government so that the bobbin lace would not be forgotten. The service design is called to explain the current situation, the activities, the organization and the infrastructure built around this craft activity. The same service design is called to intervene in the event of the International Show of the bobbin lace which takes place in Peniche. The event is one of the most important activities undertaken by the local government for the encouragement of the bobbin lace. The intervention of the service design states the important relationship of the bobbin lace as a product in relation to the lace makers who are the responsible for its implementation. We are about to present suggestions that influence and strengthen the bobbin lace as a local identity product.

Keywords Design service · Bobbin lace · International show

1 Paper

The bobbin lace is considered to be a strong reference in Peniche [1]. Peniche is situated in the east coast of Portugal. The bobbin lace is often associated with the sea as it is commonly found nearby. It is associated with fishing materials, espe-

I. Bieger (✉) · C. Carvalho · G. Montagna
CIAUD, Faculty of Architecture, University of Lisbon,
Rua Sá Nogueira—Polo Universitário—Alto Da Ajuda, 1349-055 Lisbon, Portugal
e-mail: isabelbieger@hotmail.com

C. Carvalho
e-mail: cristifig@gmail.com

G. Montagna
e-mail: g.montagna@gmail.com

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cially the fishing net which through knots and thread twists allows the beginning of the lace. The bobbin lace is woven with specific material and has the bobbin as its main instrument. Depending on the complexity of the laces, hundreds of bobbins can be used [2].

Peniche relies on the sea professions as a strong means of financial support. Fishing used to be considered one of the principal economic activities and yet, nowadays, it is still a means of support for many families. The fishing activity can not be accomplished all the year round due to the closed season. To survive Winter and hardships, the women from Peniche were obliged to find different ways of supporting their families—the bobbin lace was one of these examples. The trade on buying and selling was developed and the lace makers had the responsibility of taking orders and selling their pieces of work.

Due to this strong influence within the community, the bobbin lakes makes part of this people's culture and it is considered the identity of the people from Peniche. In addition, its population sees it this way. The history of the weave is not straightforward. From being a means of support, it has seen its period of abandonment in a short period of time. It was more important to have a fixed salary before the unknown and by those times, factories needed labour force. The bobbin lace was kept behind.

Nowadays, weaving the bobbin lace hasn't got such a financial need, the cultural symbolism has taken its place. Many lace makers still weave to keep this cultural legacy alive. It's really hard to find a person whose history is not linked to the bobbin lace. There's always someone or even a family member who weaves [3]. The local authorities recognise the importance of this activity and contribute to its creation, idealization and hold several events to keep the love for the bobbin lace alive, both locally and internationally. The objective is, in fact, to keep it alive.

2 Activities Related to It

The City Hall of Peniche still holds the *Escola de Rendas (school of lacing)* working. It is situated next to the Tourism Office and it is financed by a teacher who supports every girl who wants to work or learn there. In Summer, the school holds activities for children aiming at attracting the youngest to this activity.

A group of "the bobbin lace's friends" created an event called *"Rendas de bilros vão às escolas*" (the bobbin lace goes to school) as this group was worried about the bobbin lace's disappearance. They proposed that the bobbin lace would make part of school activities as it is at school where we can find the youngest—the aim is attracting them for this activity. The event has suffered some changes in the past few years. Nowadays, this event takes place every year, in March, in "*Pavilhão da Escola Municipal*". Instead of 'hosting' the bobbin lace, the meet it there.

A lot of talk around the subject is done there as there is a group of lace makers working at the same time, while other activities and some family reunions happen. Some students' works were exhibited as well as the partnership with *Modatex*, a

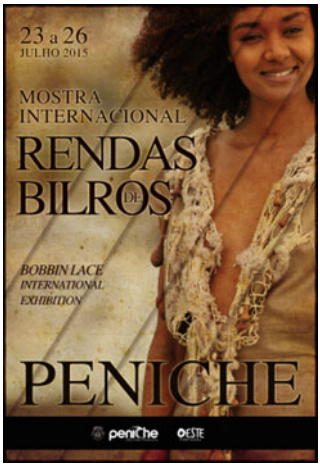


Fig. 1 Billboard on the event. *Source* City Hall of Peniche, June 2015

school of design. This fashion school allows the possibility of using the bobbin lace in clothing.

Students and visitors have had the chance of watching all of the steps for the manufacture of the bobbin lace, from its preparation up to the final product. These children have also had the chance of trying weaving for the first time, learning, this way, a little bit more about this technique which is so important for the people from Peniche.

Another activity, even more important than this one, which the local authorities invest even more is the "*Mostra Internacional de Rendas de Bilros de Peniche*" *(International Show).* This event is held annually in the last week of July—next to the celebration of the day of the lace maker. International representations from all over the globe are invited to it. They all have the weaving of the bobbin lace in common. A special schedule for these four days of event is created (Fig. 1).

The event starts with the reception to the foreign representations. Many countries were invited. In 2015, the event hosted 28 representations (according to the Peniche's Mayor speech). Then, the new products integrating the bobbin lace from Peniche were presented. A proposal from the City Hall to ESAD (Escola Superior de Arte e Design) from Caldas da Rainha, for the 2nd year of graduation in product Design. The products shown didn't have much impact during the event and the documents related to them were not handle for being studied.

In the afternoon, there was a workshop on international techniques of weaving the bobbin lace. Its organizer was the Trieste representation (Italy) represented by a lace maker, Maria. Maria emphasises the possibilities of using the traditional bobbin lace in contemporary products.

The day after, the results of the XXI bobbin lace contest were announced. The event gathered people from the local authorities who talked about the importance of the bobbin lace for the city of Peniche. After that, there were some musical performances with local musicians and then an exhibition on the "XXXIII Concurso de



Fig. 2 Exhibition of the laces presented in the contest. *Source* The lace maker, July 2014

Rendas de Peniche" (a Peniche's Lace Contest), on the lower level floor where there were 107 works and 95 participants (Fig. 2).

The next two days were dedicated to outdoor-day activities. All the representations invited had their own spot, in which they exhibited their works: there, they weaved and tried to sell their products. Thus, it was possible to know what types of works were being done in other countries concerning the bobbin lace. In addition, it gave everyone the chance of meeting new people and watching the way they work the lace. As this particular event has been held for some years, we can see lace makers from different countries socializing in a very tender way [4].

In one of those days, there was also a "bobbin lace fashion show", proposed by Peniche's City Hall to Modatex (a professional school) in order to create clothing using the lace as fashion details. In this fashion show, we could see some models walk on the catwalk and in the end of the show, the designers joined them on stage [5] (Fig. 3).



Fig. 3 Models and representative members of the local authorities after the show. *Source* The lace maker, 25th July 2015

3 Considerations and Suggestions on and for the Event

This event intends to have a global highlight. However, it is restrictive somehow due to the lack of discussion, on individual terms, with the specialized people and it doesn't count on the public opinion, either. We cannot see almost any interaction between the specialists on the bobbin lace from Peniche and 'the friends of the lace' like Associação Rendibilros. There are no 'negotiations' and the participants are simply incited to participate.

"Organize information about what customers want in a simple way that makes the patterns of value creation easily visible. As a result, you will more effectively design value propositions and profitable business models that directly target your customers' most pressing and important jobs, pains, and gains" [6, p. 8].

This procedure distances itself from what we call the service design. No matter how many events are organized, if the community involved doesn't participate in its organisation, the goals will never be achieved. All the lace makers that attend Escola de Rendas (The Lace School) are incited to participate in the contest. The objective is important but they are pressed to do it. They feel excluded if they don't do it. According to them, their main worry, all the year round, is producing a lace to participate in that contest.

Concerning the laces' contest that is held annually, wee can notice the lack of concern as far as both the lace makers and the external public or even the population is concerned. The event takes place in a small room where there are a few seats—these seats are occupied by the international guests. Thus, the seats left are not much so that other people or even the lace makers will be seated. It's fundamental to choose a bigger place to host more people and provide their participants more comfort.

During the event, we can notice a harsh relationship between the lace makers and the local authorities. Certificates are given, greetings are made but the main concern goes to the well-being of the international guests. Noone can see the interaction between them all.

The works exhibited by the lace makers are held in this same room, on the lower level floor. In addition, it is a very static place which meant to be itinerant so that the population would easily have access to it, where the works could be promoted in order to show what is done and is being exhibited. The building is a sort of isolated from the event, which takes place in the gardens, and we can see a few people visiting the exhibition.

The local authorities from Peniche but mainly Escola de Rendas, that hosts the lace makers and represents the bobbin lace all over the world, in similar exhibitions or promoting their own events, has the difficult task of having to please both sides. On the one hand, the conservative ones who want to keep the tradition the way it is. On the other hand, those who want innovation and that believe that this innovation will also lead to the bobbin lace preservation [7].

To clarify this position, we can talk about the bobbin lace Peniche's contest as it is very well divided into levels. However, the innovation level was penalized.

Innovation is quite a required and highly discussed subject to keep the bobbin lace from Peniche alive. However, the jury evaluated and accredited a 3rd place to a single work of a kind. It's embarrassing how much innovation is wanted and only considering the traditional works of the bobbin lace from Peniche. One weaves like before and it is evaluated as it used to be. For the jury, it seemed to be difficult to realise that times have changed and it is necessary to approach it to the modern or the contemporary times.

Nevertheless, innovation is a vigorous subject brought at light by all the representations invited. We suggest not only a contest with the lace makers from Peniche but also an international one. Each participant would have the chance of presenting an original piece of work. This would surely encourage the viewers to look for innovation. It would also encourage the lace makers to commit themselves in a real innovative work. Moreover, they would allow the public new views on the works produced. "The inherent intention of a service is to meet the customer's needs and, as a result, be used frequently and recommended heartily" [8, p. 28].

The organization of the event has given much importance to the fashion show designed with details from the bobbin lace, created by Modatex's students. These students are paid much more attention than the lace makers, specialized in the development of the lace. It would be fairer if every lace maker could present her work with the designer who presents it. As we all know, this is a team work so, every one participating in it should see his/her work valued: both the designer and the lace maker.

"The creation of a comfortably usable form, the development of a pictogram system, the design of an information graphic, the concept of user guidance in digital media, and in fact every kind of visual positioning in the branding of services and service organisations, needs the experience and expertise of professional designers" [8, p. 71].

In an informal conversation with different foreign representations, we realised the persistent and persevering idea that the bobbin lace must be adapted to modern times and contemporaneity.

The lace maker Helena ProškováI told us some rules that she has:

- "Do not repeat what has been done earlier. However, old traditional patterns and approaches are strongly inspiring.
- I try to move the field of my work a bit forward, to a more modern one.
- Use whatever is available.
- Do not create things that would be only stored and could not be used in real life".

Bearing in mind these rules and comparing them with the way one works in Peniche, we can state that the controversial opinions in relation to innovation, will provide bigger gaps for the bobbin lace. As we all know, the youngest aim at the novelty of the products they look for. This way, where there is no innovation, there won't be any demand.

"The creation of product development concepts can be part of iterative design work. Both conceptual and iterative design approaches are important phases in the

service design process. The challenge is to design user-orientated hybrids that incorporate both the customer facing products and that help articulate the service they assist in offering" [8, p. 55].

Talking to all the participants and those who are somehow interested in cooperating in the preservation of this valuable cultural identity, would be really positive. This way, it would facilitate and shorten the way between the producers and the services created. Design thinking activities are suggested, always accompanied by the specialists.

The objective of the design of services should concentrate itself on targeting people, i.e., if the event wants to attract people, those services should become more appealing. There are few activities for the visitors who simply accept, like the name of the event shows, a "Mostra Internacional de renda de bilros" (an international show on the bobbin lace). An exhibition of such is an event that displays products to be cherished. It has been used this way and has worked as a "shop" of local commerce of the bobbin lace and some materials. It lacks more appealing activities for the public in general. No one will ever expect that a single visit turns a visitor into a specialist. However, getting to know more about the contents, the history and the values of the community would enrich the event and would attract more people from different domains like historians and creative ones. This way, workshops to create products using the bobbin lace could be organised. They would stimulate the selling and the purchasing of materials as well as the possibilities of using the bobbin lace, in different contexts, would broaden. For this, we could take advantage of the presence of the international representations invited as through them we notice a great evolution concerning innovation, when we look at the products produced by the lace makers from other countries. This would surely be an enriching contribute for innovation itself.

The meetings between specialists from the different countries can be quite enriching in accomplishing activities of service design thinking like Crowdsourcing map, with the support of the designers.

"Therefore, we should involve all these different people in the process and we need to be creative. However, creativity is not so much a gift as a process of listening to the ideas "flowing" through one's head and being prepared to articulate them. Service designers consciously generate an environment that facilitates the generation and evaluation of ideas within heterogeneous stakeholder groups" [8, p. 31].

There is a wide range of methods and materials that can be used to develop creativity, aiming at bringing more practical solutions for the lack of demand concerning the bobbin lace. The co-creation is used as a means of facilitating the development of a service design that involves the consumers and the lace makers themselves in order to value the product more and more. The ideal would be experiencing a profound positive impact. To do so, I suggest inviting the marketing to make part of this development to enrich the product even more [9].

The relation between the public and the bobbin lace will only get better before the good experiences shared. Through these positive experiences, the ties between them could be strengthen and the bobbin lace will become an object of desire, in a

straight way between it and its user. The service design aims at improving the quality and the interaction between the product and the services given.

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References

1. Calado, M.: Peniche na História e na Lenda. Gráfica Silvas, S.L. (1991)
2. Calado, M.: História da Renda de Bilros de Peniche. Autor. Gráfica Torriana, Peniche (2003)
3. Margolin, V.: Design e o Risco de Mudança. Matosinhos: ESAD—Escola Superior de Artes e Design (2014)
4. Fuad-Luke, A.: Re-defining the purpose of (sustainable) design: enter the design enablers, catalysts in co-design. In: Chapman, J., Gant, N. (eds.) Design, Visioners and Other Stories—A Collection of Sustainable Design Essay, pp. 18–55. Earthscan, London (2007)
5. Barthes, R.: Sistema da Moda. Edições, Lisboa 70 (1967)
6. Osterwalder, A., Pigneur, Y., Bernarda, G., Smith, A.: Value Proposition Design. Wiley, Canada (2014)
7. Manzini, E.: The Material Invention—Materials and Design. The MIT Press, Milão (1989)
8. Stickdorn, Marc, Schneider, Marc: This is Service Design Thinking. BIS Publishers, Amsterdam (2011)
9. Vezzoli, Carlo, Manzini, Ezio: Sustainability, Design for Environmental. Springer, Milão (2008)

"Wow-Factors" for Boosting Business

Tero Reunanen, Marcus Penttinen and Arndt Borgmeier

Abstract WOW, that's great, what that company is doing. This comment is human factor in business context in its purest form. Wow-factor is something that won't only separate the company from others, but separates it superiorly. Wow-factor is the factor that already exists in companies' business and affects to people in many cases. It just needs to be found consciously, to be defined clearly and utilized better in order to enhance business and profits. In this article, we show different points of view about the Wow-factor in business context. Paper presents the ontology of the wow factor by utilizing literature review. Paper also presents a model for Wow-factor analyses in business. Article presents the idea of a new kind of factor for the corporate business development and brings up the overall concept of the Wow-factor in business models. Future research needs and actions are handled at the end of the article.

Keywords Human factor · Wow-Effect · Wow-Factor · Moment of truth (MOT) · Service science · Service engineering · Point of interaction (POI) · Business development

T. Reunanen (✉) · M. Penttinen
Industrial Management and Engineering, Turku University of Applied Sciences,
Sepänkatu1, 20700 Turku, Finland
e-mail: tero.reunanen@turkuamk.fi

M. Penttinen
e-mail: marcus.penttinen@turkuamk.fi

T. Reunanen
Tampere University of Technology, Pori Campus,
Pohjoisranta 11 a, 28100 Pori, Finland

A. Borgmeier
Leadership Industrial Sales and Technology, Aalen University of Applied Sciences,
Beethovenstr 1, 73430 Aalen, Germany
e-mail: arndt.borgmeier@hs-aalen.de

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1 The "Wow"

The topic of the Wow has been approached from many different perspectives, but usually there is a common factor for all of them. It is something really great and positively different. This literature review suggests the possible definition to Wow, Wow-factor and Wow-effect. The use of Wow-factor and Wow-effect can be much more when the whole term is understood. Understanding the positive uniqueness and the potential that includes in the whole concept of Wow, it can be even used in the corporate business development. To understand the meaning of Wow and the full potential, it is good to notice that the Wow itself is an outcome of Wow-effect and Wow-factor. Many times when felt or seen something extraordinary there comes in mind word "WOW" and maybe it is even said aloud.

1.1 "Wow-Factor"

The word Wow can be realized only through humans and is situation specific. It is linked to feelings or reactions when considering human behavior or in the other hand to some kind of attribute or factor that makes the product or service totally unique [1–3]. Wow is also compared with a positive surprise [4, 5]. It might be more than proper to talk about overall Wow-experience that the user experiences [6]. The experience can be divided into two category, Wow-effect and Wow-factor.

Sometimes from Wow has been used a term Wow-effect [1, 7, 8]. In those cases, the Wow is connected with a something that the user felt when she/he was dealing with a product or service that had some kind of a unique factor. The Wow-effect is a result of something that provided wave of sensation for what the user was not prepared [8]. When considering it like this, the Wow-effect can be linked to an emotional based feeling of something positively unexpected. From Wow-effect it is possible to find all the three major components that form the emotion. The three components are a subjective experience, a physiological response, and a behavioral or expressive response [9].

The Wow has been also addressed with another term, the Wow-factor [6, 10–17]. Wow-factor is not a feeling but it is more like an attribute that the product, company or service have [18]. Wow-factor is that something unique in a product, service or company that causes the user initial reactions, positive or negative [3, 19]. When the Wow-factor is brought up as a positive attribute, it is possible to think that with this factor it is some way possible to positively enable the Wow-effect. Wow-factor is also connected with a rewarded feeling, to an experience that could otherwise be unobtainable without that special Wow-factor of certain product, service or company [20].

Along engineering the term 'Wow-factor' has mentioned to be one of those "drivers" that influences individuals to choose that field [21]. It is also connected with reflecting the result of the solution oriented search for understanding and

knowledge. Wow-factor has also mentioned to be as a force for positive change, reflected in the excitement and uniqueness of the engineering [21].

There are also other meanings for WOW as an acronym. For Tokman et al. [22]. for instance, referred WOW to be a "perceived overall value of the offer extended to defected customers in an effort to attract these customers back to their previous service supplier", the Win-back offer worth (WOW). But this study is researching Wow mainly in a customer retention sense whereas many other aspects (see Chap. 4 Academic Discussion).

In this study will also introduce a model for Wow-factor analyses in business. This model is developed by combining business model analyses and quality analyses and applying its unique results in specific nature of Wow-factor. The article presents the idea of a new kind of factor for the corporate business development and brings up the overall concept of Wow-factor in business models.

1.2 Customer Wow

Feeling the overall Wow-experience is really important for a customer [1]. When the customer finds out that there is really something positively unique she/he will definitely remember you and remember that you were different. A satisfied customer is a returning customer and also a recommending customer.

Customers need to be given more and more something positively different than what they expect. Something that will turn out to be positively more than what they wanted or needed. Decreasing focus towards product developing to achieve something that delights the customer, developing something that gives the customer the Wow, is increasing among companies [2]. When the positively delighting is forgotten from the product development, it may lead towards to a dull product or service in the eye of a customer. When that happens, it is more than probable that the customer will choose another product or service.

The customer must feel impressed and it is good to remember that they are individuals. Customers need to see and feel your product or service as the best there is. The whole experience is needed for this, starting from the very beginning even there isn't a customer in the picture, ending to that point when the customer has left [23].

1.3 Business Wow

Corporations that are compartmentalized, are not afforded to keep running anymore in today's world. Where the number of competitors is only increasing and the pace of doing business is clearly becoming faster. This will affect every company, not depending what your business is [2]. Because of the reasons mentioned above, it is

becoming essential for companies to find what the Wow what they are doing is, clearly define it and keep developing it.

Products or ideas should be taken further and further, at least one step further than competitors, because those cannot be ignored. Innovations that are radical are the only ones that can generate a Wow response [24]. Competing with the price alone may lead to failure, because it is more than possible that sometimes being aware of competitor's actions may turn to being more and more alike to competitors [1]. When the business, what you are doing, turns into the same kind as your competitors, the unique factor what you had disappears. Losing the unique factor will lead towards the fact that the customers do not see your business as different and attractive anymore.

1.4 Employee Wow

All of the employees need to feel what the company's Wow is and invest in it every day. To reach a continuous investment process with Wow, it isn't enough if only one or few of the employees works towards the Wow [1]. Employees are the resource for company to reach the wanted Wow-factor so the customers can feel the Wow-effect. That is the reason why the Wow needs to be transmitted to all of the employees and they need to engage in the matter to reach it. With a developed plan, it is possible to get employees to engage to company's Wow and that way it will transfer to customers [4].

Motivating employees with the presence of factors and activities, particularly with those kinds that are coming from a managerial point of view and consider sincerity and trust, are likely to lead results where the employees have a possibility to feel the Wow themselves and that way transfer it forward [25].

2 Wow Gaps

Good Wow-factors are like good quality, we can recognize it when we see it, but just as quality, it can be very difficult to define them unambiguously. How to measure quality or even define perceived quality is still a constant matter of debate [26, 27–31]. Nevertheless, ways to create Wow-effect should be done by defined Wow-factors. I.e. company should be consciously aware what their Wow-factors are and how they should create Wow-effects. Metrics for this kind of measuring is therefore needed. Our study didn't find any metrics for Wow-factors so those should be created. However before metrics can be created and defined some kind of concept should be used in order to clarify Wow-factors and -effects at organizational level.

2.1 SERVQUAL Framework

Since Wow-factors are like quality this research uses SERVQUAL quality management framework as in the development of framework for Wow-factors at an organizational level, as it is suitable for structuring "understanding service quality, measuring service quality, diagnosing service quality problems". SERVQUAL was developed by Parasuraman et al. [32] in order to measure service producers' quality and was defined to be "global judgement, or attitude relating to the superiority of the service" [33]. The quality of services is still something which is even harder to measure than the quality of goods, because the quality evaluations include, not only the performance of service, but also the process of service delivery [33] and service is evaluated after performance and delivery [34] and all these judgements are done against customer expectations [33, 35]. Firstly Parasuraman et al. [26] ended with 10 dimensions in SERVQUAL but later ended to 5 dimensions: (1) Reliability, "ability to perform the promised service dependably and accurately", (2) Assurance, "knowledge and courtesy of employees and their ability to convey trust and confidence", (3) Tangibles, "appearance of physical facilities, equipment, personnel and communication materials", (4) Empathy, "provision of caring, individualized attention to customers" and (5) Responsiveness, "willingness to help customers and to provide prompt service". [36, 27] SERVQUAL approach consists of 5 distinguished gaps between perceptions and expectations of quality [33].

1. The gap between consumers' expectations and management perceptions of consumers' expectations
2. The gap between perception of the management and specification of service quality
3. The gap between the service quality specification and delivery of service
4. The gap between delivery of service and external communications to customers
5. The gap between expected service and experienced service

SERVQUAL is not the only model which is developed for service quality. There are many different models developed during the years. Ninth et al. reviewed 19 different models. Seth et al. [30]: Technical and functional quality model [37] GAP model [26], Attribute service quality model [38], Synthesised model of service quality [39], Performance only model [40], Ideal value model of service quality [41], Evaluated performance and normed quality model [42], IT alignment model [43], Attribute and overall affect model [44], Model of perceived service quality and satisfaction [45], PCP attribute model [46], Retail service quality and perceived value model [47], Service quality, customer value and customer satisfaction model [48], Antecedents and mediator model [44], Internal service quality model [49], Internal service quality DEA model [50], Internet banking model [51], IT-based model [52], Model of e-service quality [53], to mention some of the most well-known models. Even that critics are set to SERVQUAL model [36, 40, 54, 55], it still seems to be one of the models which is a base for many others and seems to get support from researchers as a basic model [30].

2.2 Wow Gap Model

Wow gaps model is illustrated in Fig. 1. The Figure shows a simplified system dynamic model from how Wow-effect can be examined. Customer expectations are consisting of needs, the words of mouth, past experiences [26] and expectations made by marketing and sales. Signals from the markets to management are typically delivered by marketing and sales by market researches and sales representatives' reports. But interests, personal biases and expectations of management, not to mention that management too, have their words of mouths, needs and past experiences influencing their perceptions [56]. Company existence is company as shown to the customer. This doesn't mean that company has to own or operate all issues included in company existence, but these issues are shown to customers. For example a small barber shop in a shopping mall is probably not responsible if mall's security personnel are behaving inconsiderately or if the shopping mall renovates the entrance hall to very wondrous, but it affects also the barber shops image and perceived experience of barber shop's customers. Therefore the term 'company existence' is used to describe everything what is visible to the customer. There is also a need for common understanding for the targeted Wow-factor in company's production. The term production here contains everything from the physical product's manufacturing process and its delivery to home via grilling the perfect stake in a restaurant and serving it to a customer to a complex consultancy of law advocates in IPR law case. These products, services and their deliveries are all different, but they could be understood as production processes. Therefore all personnel taking part in these processes should pursue same Wow and employees should experience that they are part of the Wow too. Wow-effect can also be pursued by marketing, advertising and sales, but in this research this Wow-effect is combined more to promises about products or services than claiming this promise. When claiming the promise, Wow-factors can be seen as determinants with extreme satisfaction. Berry et al. [57] found that the satisfying determinants are the obverse to dissatisfying ones e.g. friendliness satisfies and unfriendliness dissatisfies. But as Johnston [58] found this is not the case in all determinants. This is also the case in Wow-factors. If the factor is not giving Wow-effect, this doesn't mean that factor is not good or unpleasant, it is just not exceeding expectations enough for Wow.

As seen from the Fig. 1 there are 7 distinctive gaps between different stakeholders.

1. Gap between Markets and Management,
2. Gap between Management and Marketing & Sales,
3. Gap between business definition and Company Existence,
4. Gap between Existence and Specification,
5. Gap between Production output (includes product/service delivery),
6. Gap between Production output and Perceived Experience, and
7. Gap between Customer's Expectations and Perceived Experience.

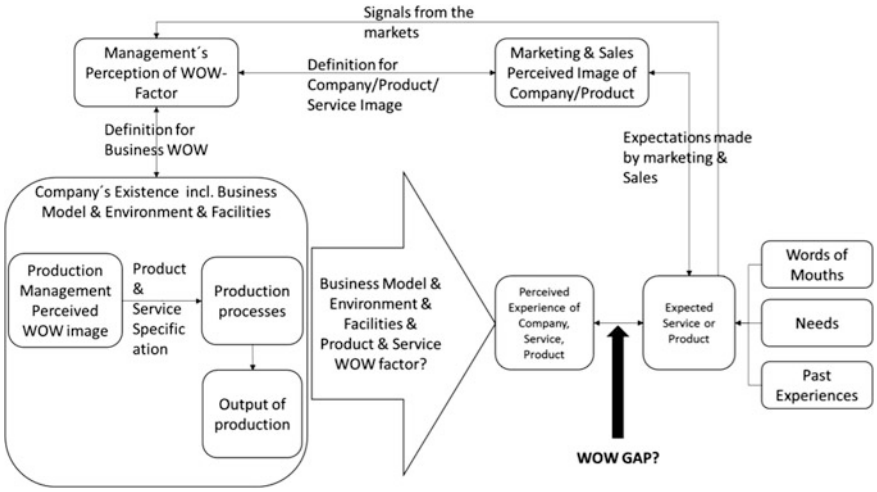


Fig. 1 Wow gap model

When the Wow-effect is defined to be surprise [4, 5] and extraordinary or unique [1–3] the most interesting gap is then gap number 7 "the Wow gap". If a customer is experiencing Wow-effect, this means that customer's expectations are exceeded more than expected. Even when a customer is not having a Wow-effect, product or service may be overwhelmingly good but for some reason this particular customer was not affected that much by Wow-factors the company produced.

3 Business Models and Service-Related Aspects

Recent business model discussion takes up mainly three aspects "value/benefit", "structure of the value chain/network" and "profit model" [59]. In all the three important aspects, Wow has significant interference:

(a) The Wow itself could be interpreted as a value proposition or benefit.
(b) Transactions in the value chains could be enabled, speeded-up or optimize processes
(c) This should directly reflect in the price payment willingness or indirect via calculation on faster, better and cheaper outcomes. These all influence the profit of companies

Further developed, like in the Business Model Canvas Concept [60], it even structures the areas in which Wow occurs further. It could even be triggering business model innovation in different arenas that still is under research. Especially in an era of M2M, IoT or German term "Industrie 4.0" new business models involve services. Two principles, either mainly the improvement of operations or

the use of gained data as new "raw material" for new services, a base of cooperation and capitalization for information and knowledge purposes. Latest provide a new quality for Wow-effects by creating unexpected processes and products that surprise. The orchestration or staging of these services and outcomes will be another arena to research.

4 Discussion

The Wow discussion is complex and multidisciplinary.

In marketing and sales the staging and orchestrating of the Wow and its environment can be regarded as a new research task. According to the famous Kano-model [61] an over fulfilling of individual expectations seems to be relevant to customer satisfaction and experience of that effect. Moreover non-linearities and over proportional disseminations of that experience of the customer/partner e.g. through the means of social networks [62] becomes an issue. Recent modern marketing terms and issues [63] e.g. on "customer satisfaction," "words of mouth" [64] or even the "customer journey" can be regarded as consequences and traced back on this effect. This makes "Wow" probably "the" most important antecedent for many research oriented aspects of marketing.

The cognitive understanding about the Wow, the "more than expected" Wow-feeling with customers and its measurement through physical evidence like change of pupil diameter, heart beat rate etc. becomes a new field in socio-medical disciplines.

Business models could also be further developed by taking the Wow as a new parameter into account: the expected bigger willingness to participate in cooperative efforts and providing service-relevant input into joint transactions will have effects in quality, time and costs of processes and outcomes.

Especially in services, defined as mainly intangible products—generated in a coproduction of resources of the service providing party and the service receiving party generating benefit at the customer site—has an enormous potential to generate "Wow". In the area of personal interaction in services it expresses all the three dimensions. Especially Service science has already taken up some aspects of Wow reflecting in terms like "moment of truth (MOT)" [65] e.g. in "service blueprinting" or vignette or "critical incident techniques (CIT)". Due to the intangibility of service products the Wow could be even the only differentiation criteria creating or at least influencing the unique selling proposition USP of a supplier.

The Wow concept provides powerful and comprehensive multidisciplinary insights into business and enables backing many modern and powerful concepts, here shown on the gap-model. Besides explanatory capability there are very promising connections which still have to be revealed more thoroughly, by developing Wow approach through distinctive linkages between human, business and management aspects. This may emerge new, unique and motivating power to business development. Wow touches human factors and feelings and because of

that it is possible to touch the humans' intrinsic motivation with it. Every company and organization has its own and unique Wow-factors. Companies' and organizations' customer relationships, as well their own internal processes, consist of human interactions, and every human is an individual person with personal unique features. These features can be affected by Wow-factors, special attributes of the company and what company is doing and the uniqueness in it. Wow just needs to be approached with a positive and open-minded attitude to understand and reach the full potential in it.

4.1 Future Research Issues

The results of this research give insight for the future of the modern business development. The way to find out what company's Wow-factor is, needs a method. Because Wow touches peoples' feelings, the method for finding the Wow should be a way to give people the opportunity to tell their own feelings and what is that great, unique and positive thing what company is doing. Which will be the questions which open up peoples' mind to tell their positive feelings, or lack of it? Can those different kind of answers be analyzed and combined as a unified and formal method of Wow-factor and Wow-effect.

The method of finding the Wow-factor and Wow-effect, needs also a way to track how the Wow flows through the company or organization. How to track this flow or how to find where it possibly biases? The tracking model should be a comprehensive model which covers both internal and external factors of the companies' and organizations' business model.

Future research should also be done to focus on to the results that the Wow-factor and Wow-effect really influence on companies turnover and profitability. One important question for the future is how significant the influence on turnover and profitability is, if any, and could the Wow-factor also be harmful in some cases?

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References

1. Cohen, B.: The "WOW" effect: how one restaurateur continues to delight customers. Cornell Hotel and Restaurant Adm. Q. **38**(2), 74–81 (1997)
2. Randall, R.M.: Putting the 'wow' back in strategy and marketing. Plann. Rev. **23**(3), 20–22 (1995)
3. Murray, L., Barnes, A.: Beyond the wow factor—evaluating multimedia language learning software from pedagogical viewpoint. System **26**, 249–259 (1998)

4. Shams, R., Alpert, F., Brown, M.: Consumer perceived brand innovativeness: conceptualization and operationalization. Eur. J. Mark. **49**(9/10), 1589–1615 (2015)
5. Prakash Vel, K., Sharma, R.: Megamarketing an event using integrated marketing communications: the success story of TMH. Bus. Strategy Ser. **11**(6), 371–382 (2010)
6. Levin, R.P.: How to win in a tough economy with superior customer service. Alpha Omegan. **102**(3), 98–100 (2009)
7. Eber, D.E.: Computer graphics curricula in the visual arts. Comput. Graph. **24**, 919–923 (2000)
8. Pizam, A.: What happened to the quality of services revolution? Hospitality Manage. **23**, 201–202 (2004)
9. Moore, G.A.: Technology and social communication. Technol. Soc. **18**(2), 253–260 (1996)
10. Geddes, L.: Model of surprise has 'wow' factor built in new scientist. **201**(2691) 9 (2009)
11. Chandler, P.: Dynamic visualization and hypermedia: beyond the Wow factor. Comput. Hum. Behav. **25**, 389–392 (2009)
12. Tillman, B.: Creative Character Design. Elsevier, Oxford (2011)
13. Caldwell, T.: Education, education, education. Biometric Technol. Today. **2010**(3), 10–11 (2010)
14. Kortum, P.: From HCI Beyond the GUI: Design for Haptic. Speech, Olfactory and Other Nontraditional Interfaces (2008)
15. Kirby, A.: Coors turns new employees into ambassadors for beer: Induction program seeks to impart the "wow" factor. Hum. Res. Manage. Int. Digest. **13**(6), 30–32 (2005)
16. Muir, P.: The rebirth of St Pancras: matching service to facilities: recruitment and induction of customer-service officers have the "wow" factor. Hum. Res. Manag. Int. Digest. **16**(2), 11–16 (2008)
17. Morris-Knower, J.: Selling the wow: Albert R. Mann library´s virtual tour. New Libr. World. **102**(3), 83–87 (2001)
18. Slevitch, L., Mathe, K., Karpova, E., Scott-Halsell, S.: Green attributes and customer satisfaction: optimization of resource allocation and performance. Int. J. Contem. Hospitality Manage. **25**(6), 802–822 (2013)
19. Musa, N.A.O.R.: Measuring service quality in retail loyalty programmes (LPSQual): implications for retailers' retention strategies. Int. J. Retail. Distrib. Manag. **39**(39), 759–784 (2011)
20. Capizzi, M.T., Ferguson, R.: Loyalty trends for the twenty-first century. J. Consum. Mark. **22** (2), 72–80 (2005)
21. Clark, R.: Today's pupils, tomorrow's engineers! pedagogy and policy: a UK perspective. J. Eng., Design, and Technol. **9**(2), 227–241 (2011)
22. Tokman, M., Davis, L.M., Lemon, K.N.: The WOW factor: creating value through win-back offers to reacquire lost customers. J. Retail. **83**, 47–64 (2007)
23. Levin, R.P.: The complete new patient experience: A proven approach to maximizing patient´s introduction to your practice. Inside Dentistry. **11**(2) (2015)
24. Lowe, B., Alpert, F.: Forecasting consumer perception of innovativeness. Technovation **45–46**, 1–14 (2015)
25. Paswan, A.K., Pelton, L.E., True, S.L.: Perceived managerial sincerity, feedback-seeking orientation and motivation among front-line employees of a service organization. J. Ser. Mark. **19**(1), 3–12 (2005)
26. Parasuraman, A., Zeithaml, V., Berry, L.L.: A conceptual model of service quality and its implications for future research. J. Mark. **49**(4), 41–50 (1985)
27. Parasuraman, A., Zeithaml, V., Berry, L.L.: SERVQUAL: a multiple-item scale for measuring consumer perceptions of service quality. J. Retail. **64**(2), 12–40 (1988)
28. Brady, M.K., Cronin, J.J.: Some new thoughts on conceptualizing perceived service quality: a hierarchical approach. J. Mark. **65**(July), 34–49 (2001)
29. Ekinci, Y.: The validation of the generic service quality dimensions: an alternative approach. J. Retail. Consumer Ser. **8**(6), 311–324 (2001)

30. Seth, N., Deshmukh, S.G., Vrat, P.: Service quality models: a review. Int. J. Qual. Reliab. Manage. **22**(9), 913–949 (2005)
31. Parasuraman, A., Zeithaml, V.A., Berry, L.L.: Alternative scales for measuring service quality: a comparative assessment based on psychometric and diagnostic criteria. J. Retail. **70**(3), 193–194 (1994)
32. Zeithaml, V.A., Parasuraman, A., Berry, L.: Delivering quality service: balancing customer perceptions and expectations. J. Econ. Lit. **28**(4), 1868 (1990)
33. Zeithaml, V.A., Berry, L.L., Parasuraman, A.: Communication and control processes in the delivery of service quality. J. Mark. **52**(2), 35 (1988)
34. Swartz, T.A., Brown, S.W.: Consumer and provider expectations and experience in evaluating professional service quality. J. Acad. Mark. Sci. **17**(2), 189–195 (1989)
35. Zeithaml, V.A., Bitner, M.J.: Services Marketing: Integrating customer focus across the firm, 2nd edn. Irwin/ McGraw-Hill, Boston, M.A (2000)
36. Buttle, F.: SERVQUAL: Review, critique, research agenda.European J. Mark. **30**(1), 8–32 (1996)
37. Grönroos, C.: A service quality model and its marketing implications. Eur. J. Mark. **18**(4), 36–44 (1984)
38. Haywood-Farmer, J.: A conceptual model of service quality. Int. J. Oper. Prod. Manage. **8**(6), 19–29 (1988)
39. Brogowicz, A.A., Delene, L.M., Lyth, D.M.: A synthesised service quality model with managerial implications. Int. J. Serv. Ind. Manag. **1**(1), 27–44 (1990)
40. Cronin, J.J., Taylor, S.A.: Measuring service quality: a re-examination and extension. J. Mark. **6**(July), 55–68 (1992)
41. Mattsson, J.: A service quality model based on ideal value standard. Int. J. Serv. Ind. Manag. **3** (3), 18–33 (1992)
42. Teas, K.R.: Expectations, performance evaluation, and consumers' perceptions of quality. J. Mark. **57**(October), 18–34 (1993)
43. Berkley, B.J., Gupta, A.: Improving service quality with information technology. Int. J. Inf. Manage. **14**, 109–121 (1994)
44. Dabholkar, P.A., Shepherd, C.D., Thorpe, D.I.: A comprehensive framework for service quality: an investigation of critical conceptual and measurement issues through a longitudinal study. J. Retail. **76**(2), 131–139 (2000)
45. Spreng, R.A., Mackoy, R.D.: An empirical examination of a model of perceived service quality and satisfaction. J. Retail. **722**, 201–214 (1996)
46. Philip, G., Hazlett, S.A.: The measurement of service quality: a new P-C-P attributes model. Int. J. Qual. Reliab. Manage. **14**(3), 260–286 (1997)
47. Sweeney, J.C., Soutar, G.N., Johnson, L.W.: Retail service quality and perceived value. J. Consumer Ser. **4**(1), 39–48 (1997)
48. Oh, H.: Service quality, customer satisfaction and customer value: a holistic perspective. Int. J. Hospitality Manage. **18**, 67–82 (1999)
49. Frost, F.A., Kumar, M.: INTSERVQUAL: an internal adaptation of the GAP model in a large service organization. J. Serv. Mark. **14**(5), 358–377 (2000)
50. Soteriou, A.C., Stavrinides, Y.: An internal customer service quality data envelope analysis model for bank branches. Int. J. Bank Mark. **18**(5), 246–252 (2000)
51. Broderick, A.J., Vachirapornpuk, S.: Service quality in internet banking: the importance of customer role. Mark. Intell. Plann. **20**(6), 327–335 (2002)
52. Zhu, F.X., Wymer, W.J., Chen, I.: IT-based services and service quality in consumer banking. Int. J. Serv. Ind. Manag. **13**(1), 69–90 (2002)
53. Santos, J.: E-service quality: a model of virtual service quality dimensions. Managing Ser. Qual. **13**(3), 233–246 (2003)
54. McCabe, D., Rosenbaum, M., Yurchisin, J.: Perceived service quality and shopping motivations: a dynamic relationship. Ser. Mark. Q. **29**(1), 1–21 (2007)
55. Lages, L., Fernandes, J.: The SERPVAL scale: a multi-item instrument for measuring service personal values. J. Bus. Res. **58**(11), 1562–1572 (2005)

56. Kahneman, D.: Thinking, fast and slow. Farrar, Straus and Giroux, New York (2011)
57. Berry, L.L., Zeithaml, V.A., Parasuraman, A.: Quality counts in services, too. Bus. Horizons. pp. 44–52 (1985)
58. Johnston, R.: The determinants of service quality: satisfiers and dissatisfiers. Int. J. Serv. Ind. Manag. **6**(5), 53–71 (1995)
59. Stähler, P.: Geschäftsmodelle in der digitalen Ökonomie. Eul Verlag, Köln-Lohmar (2001)
60. Osterwalder, A., Pigneur, Y., Smith, A.: 470 practitioners from 45 countries. Bus. Model. Gener. self-published. (2010)
61. Kano, N., Nobuhiku, S., Fumio, T., Shinichi, T.: Attractive quality and must-be quality. J. Jap. Soc. Qual. Control. **14**(2), 39–48 (1984) (in Japanese)
62. Kietzmann, J.H., Canhoto, A.: Bittersweet! Understanding and Managing Electronic Word of Mouth. J. Public Affairs. **13**(2), 146–159 (2013)
63. Grönroos, C.: Service management and marketing: managing the moments of truth in service competition. Lexington Books, Lexington (Mass.) (1990)
64. Dichter, E.: How Word-of-Mouth Advertising Works. Harvard Bus. Rev. **44**(6), 147–166 (1966)
65. Carlzon, J.: Moments of truth. Harper Perennial, New York (N.Y.). (1987)
66. Hockenbury, D.H., Hockenbury, S.E.: Discovering Psychology. Worth Publishers Inc, New York (2007)

City Branding and the Way It Is Perceived in People's Mind, a Case Study of Milad Tower in Iran

Ashkan Bayat

Abstract In today's world city branding is one of the important instrument in order to receive the city to high economic situation. Historically, city branding has started with establishing the first city by human, where people wanted to use some structure to show their power to their enemies. Cities today are in challenge together to attract tourism and creative class in order to promote economic finance and their World-renowned and global credit; so that the concepts of brand strategy for cities are increasingly considered from the commercial world and used as a process in pursuit of urban development, regeneration and quality of life. Place branding is the management of place image through strategic innovation and coordinated economic, commercial, social, cultural, and government policy. In this paper the term City Branding is been explained and it is investigated that whether the Milad tower in Tehran metropolis is a brand in observer's mind or not.

Keywords City branding · City identity · Observer mind · Milad tower

1 Introduction

Globalization has increased competition among cities in both national and international level. Such competition is for attention, influence, markets, investment, business visitors, talents, and significant event. For being a winner in this competitive environment, cities need to use a wide variety of tools which one of them is the city branding. City branding regarded as a strategic tool to publicize the city's competitive advantage. For being succeed in city branding, identifying and defining the characteristics of the city is a critical task [1].

Historically, city branding has started with establishing the first city by human, where people wanted to use some structure to show their power to their enemies.

A. Bayat (✉)
Department of Urban Planning, Islamic Azad University, Najafabad Branch, Najafabad, Iran
e-mail: Ashkan_bayat2001@ymail.com

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But considering it as a strategic program is much younger. At the late 1960s, a new concept, city boosterism has been introduced. Actually it was the marketing of a product which was as an identification of the city. Place branding which invented after city boosterism in 1980s, is the marketing of a place that make the city specified [2].

The reasons for the creation of city branding can be found in city boosterism. Boosterism is the act of "boosting," or promoting, one's town, city, or organization, with the goal of improving public perception of it [3]. Therefore, cities, for elevating their images in peoples mind was used their products advertising and marketing; in this way they were declared themselves to the observers.

The concept of place branding was proposed in theories in later 1980, including: nation branding, region branding, city branding [4]. Employing branding strategy for small scales within cities is new urban designers/planners issue that has been neglected. In this regard, the paper is seeking to investigate how to use branding strategy in small scales such as urban space places. The question emerges here is that how one unknown place could be a brand of its city and what could be done by means of city designers and planners in order to improve the one place's image on visitors mind in order to change one unknown place to known one in the national and international level.

2 Definition of Brand

A brand is an impression perceived in a client's mind of a product or a service. It is the sum of all tangible and intangible elements, which makes the selection unique [5]. A brand is enduring in the most people's mind and attracts more people's attention. A Brand, defined by the American Marketing Association, is a "name, term, sign, symbol, or design, or a combination of them intended to identify the goods and services of one seller or group of sellers and to differentiate them from those of competition". A brand is an impression perceived in a client's mind of a product or a service and it is the sum of all tangible and intangible elements, psychological and sociological features related to the product, which makes the selection unique [6]. Brands are created, stimulated and applied by people working in organizations seeking to create worthwhile experiences for their customers that will induce behavior beneficial to the organization [7]. Shaping brand occurs in the viewer's mind; one brand has three essential concepts that are related to it: identity; image; and communication. The identity of the brand is defined by the creator of it and include the features that the owner of brand wants to be perceived, the features like: functional, emotional and self-expressive benefits. On the other hand, brand image is the real image remains in the observer's mind. In order to make connection between chosen factors of the identity and observer's mind is needed to communication like advertising. It is the way that introduces the brand identity to the customers. What we name Brand, is totally positive and negative part of an element

perception. At first step, there is owner of brand, that try to creates it with positive aspects, but second step depends on a observer's perception and background about this product and even the way that product be promoted. Each product, company, region, nation, country or city could be introduced by specially brand to the customer and observer.

3 City Branding

Cities today are in challenge together to attract tourism and creative class [4], in order to promote economic finance and their World-renowned and global credit; so that the concepts of brand strategy for cities are increasingly considered from the commercial world and used as a process in pursuit of urban development, regeneration and quality of life. "Place branding is the management of place image through strategic innovation and coordinated economic, commercial, social, cultural, and government policy. Competitive identity (CI) is the term to describe the synthesis of brand management with public diplomacy and with trade, investments, tourism and export promotion". In fact the goal of city branding is to make a connection between city identity and perceived images through memorable city experiences and projected images.

City branding can be looked upon as a refreshing of urban identity or as the creation of new forms of identity [8]. According to Khirfan and Momani proposed model, the city's refreshed identity is shaped by physical interventions, events and activities, and place representations that are based as much on the city as on its consumers. Cities should have depth, originality, and a distinct character though the materialization of choice, diversity, and distinguishing features [9]. Thus, branding contributes to the construction of local identity [10].

It is the city spaces that can be classified as distinct brand through linking the visual image of these areas to the brand image by holding several cultural, social and economic activities with the importance of declaration about it by several ways aiming at strengthening the urban character of the place, in a way that enable it to compete globally through presence of valuable urban and historical elements.

City places have become relatively Substitutable [6]. place substitutability made locational branding *inevitable* in consequence of the ever-growing globalization of business investment and the ferocious nature of the competition among places to attract employing companies, to host major sporting or cultural events, or to become centers for tourism [11].

In order an element to be enduring brand in people's mind (both residents and tourists). It should include two Characteristics: functional and added value. Again in this part, functional features refers to the creator of brand, for example the functional goals of building Eiffel tower are: aerodynamic measurements, studies of the resistance of substances, physiology of the climber, radio electric research, problems of telecommunication, meteorological observations, etc. [5]. Indeed the

tower is an original monument that looks at Paris, The tower is identical with the urban landscape and remains in observer's mind in first sight and this is added value of Eiffel tower that will be described later.

4 Observer's Mind

It is generally accepted in the literature that, in the people's minds, the perceived place image is formed by two 'distinctly different but hierarchically interrelated components: cognitive, affective and [according to some] conative' [12]. 'Cognitive evaluations refer to the beliefs or knowledge about place attributes whereas affective evaluation refers to feelings toward, or attachment to it' [13]. 'The affective component of image is related to the motives one has for destination selection' [14]. The conative component, on the other hand, 'is the action component which builds on the cognitive and affective stages' [15]. Beerli and Martín provide evidence for this, as they have established empirically that: (i) motivations (as affective psychological characteristics) influence the affective component of image; (ii) the experience of travel (as in learning as a psychological characteristic) has a significant relationship with cognitive and affective images; and (iii) the socio-demographic and personal characteristics (gender, age, level of education, occupation, country of origin and social class) influence the cognitive as well as the affective assessment of image [6, 15].

According to the information stored- in the previous times in part cognitive-about for example one city, we could introduce subcategories of added values characteristic, including: perception, people's experience of the city, belief in the city, appearance of the city. Residents' thinking and dependency to their hometown or where they work can influence the perceptions of tourists and visitors. To retain residents of the city and attract tourists, city policy makers and urban designs should Strengthened residents' everyday experiences to encourage their long-term commitment.

5 Various Types of City Brands Classification

In the literature, three main categories of urban image carriers have been identified: the built environment, hallmark events and famous personalities [9]. In this essay we try to fragment these three general categories and some others.

City brands components includes: city Natural landscape like Niagara falls as a brand of Ontario city in Canada, city Artificial landscape like Gardens and palace of Versailles in Paris, architectures like Petronas tower in Kuala Lumpur, Malaysia, Prominent Urban designs as design of Squares and streets like The Piazza d'Italia, Designed in 1978 by renowned architect Charles Moore, Climate like Cloudy London, historical events like 11th September, important international events like

Olympics races in Beijing, special product of a city like Isfahan crafts in Iran, Urban Industry as known factories, like Ferrari company in Maranello, Italy.

6 Processes of Making Brand

City planners must began with basic requirements of living, working and playing in urban communities such affordable and accessible housing, transport, healthcare, education and training, retail outlets, other public amenities, and opportunities for social interaction. If these functionally needs provided well down in one city, the opportunity is created for the people to perceive unique index of the city. We should pay attention to the most popular objects that are different from what people usually encounter at home or work—they are different in terms of scale, meaning or experience. Like Guggenheim Museum in Bilbao or remains of the Berlin Wall [16].

Kavaratzis proposes that city branding ensues from the interaction between an internal and an external city. Whereas the former is based on physical structure (landmarks), the latter is embedded in the intangible characteristics (subjective perceptions) that unite complex mental messages about the city [3].

To retain residents of the city and attract tourists, city policy makers and urban designs should Strengthened residents' everyday experiences to encourage their long-term commitment. In fact the goal of city branding is to make a connection between city identity and perceived images through memorable city experiences and projected images [15]. If these events influence majority's mind, then it brings about a situation which is the trigger in shaping a city branding [17].

Regarding to urban designing, these events could contribute to either city identity or city image. The reason which explains why the research has been underscored city image and identity in order to reach a successful city branding is behind the fact that Place branding links place identity with projected and perceived images through communication and experience. The brand strategy for a city must appeal to 'outsiders' as well as residents. a strong place brand cannot be built on projected images alone, it needs to incorporate a high involvement experience concept—supported through infrastructure, projects, events and place development initiatives—in order to build a primary place image [7].

The process of Creating city brand should start with a strategic analysis of the city like SWOT, to finding the strength and weakness, and concentrate on the strengths of the city, on its existing basic substance [13].

To categorize elements of place identity as structural elements (location and history); semi-static elements (size, physical appearance and inner mentality); and coloring elements (symbolism, behavior and communication). Structural elements that are pretty well unchanging—the DNA of place if you like—are location (geography and climate) and history (roots). Semi-static elements that can be changed, but that take time to transform, include size and physical appearance, such as superstructures, infrastructure, land-use planning and landscape. Also included

as a semi-static element of place identity is the inner mentality of the population, as in the cultural and religious values, often embodied in language [17]. Coloring elements include symbols (names, logos or emblems such as flags, costumes, folk dances or maps), behavior and communication [14].

7 Conclusion

When we talk about a city, what is the first thing that passes to our mind?

This is the simplest question that we can use about city branding. According to the research small percentage of the residents of Tehran and people in other cities that visited capital know Milad tower as a brand of Tehran! Most of them in reply to the mentioned question, discusses pollution and car traffic. Therefor in some cases, the negative features of one city can influence the index that has capability to be a brand.

Characteristics of brand is mentioned in this essay, now we are trying to introduce different parts of these characteristics and deliberate them about

Milad tower:

Functional features of a city brand includes: promotion of economic, employment, recreation, and attractions. In other word in order one city landscape to be a brand, it should be functional at first step. Our case study, Milad tower is part of The Tehran International Trade and Convention Center. The project includes the Milad telecommunication tower offering restaurants at the top with panoramic views of Tehran, a five-star hotel, a convention center, a world trade center, and an IT park (Congress Venue). Every year different international and internal conferences are held in this tower and its conference hall and five-star hotel is receptive foreign guests. These international conferences are the most cause of visit of this tower; thereupon one way to declare Milad to the people is held up varied congresses.

The second Characteristics of city brand is added value defined by four concepts: people experiences of the city, perception, belief in the city, and appearance. As this tower is the tallest one in Iran, it could have approximately persistent affection on people mind especially from the point of direction; so that citizen or tourist at any point of Tehran could identify the west and determine its path.

In other hand, being in one place and sensing the place directly, has a great impact in making the image of it, but unfortunately because of the high entrance and restaurants prices few are willing to go and visit the place.

By the way due to this fact that Milad tower is not residential and commercial tower, ordinary people and public have low chance to visit the tower without paying cash.

What are the solutions in order to change Milad tower to the brand of Tehran?

Today's marketing and advertising have important rule in introducing a product to people. This could be from different ways such media like: TV, radio, and specially internet. Milad's five-star hotel could advertise in the internet agencies for attract tourist.

The effort should be provide more access to this tower. For example, its restaurants with serving low price foods could be advertised for ordinary people.

More information from the features of this tower should be available to the public. Including the architecture of tower, structure of it, the reasons for building Milad tower and its position in today's world.it can be by publishing the books, or SMS.

Milad tower Built in between the Shahrak-e Gharb and Gisha districts of Tehran, in fact our case study is a strong sign in the city according to the lynch, therefor we can make it stronger with urban designs solution; like reinforce this sign with the ways in which get along to it.

References

1. Anholt, S.: Competitive identity: the new brand management for nations, cities and regions. Palgrave Macmillan (2007)
2. Kapferer, J.: The new strategic brand monugment: creating and sustaining brand equity long term. Kogan Pages Publishers. 364. ISBN 180749450854 (2008)
3. Kavaratzis, M, Ashworth, G.: City branding; an effective assertion of identity or a transitory marketing trick?. **96**(5), 506–514 (2004
4. Bathes, R.: The Eiffel Tower and other Mythologies (1997)
5. Bennett, P.: Dictionary of marketing terms, 2nd edn. American Marketing Association, Chicago, IL (1995)
6. Beerli, A., Martín, J.D.: Tourists' characteristics and the perceived image of tourist destinations: a quantitative analysis—a case study of lanzarote. Spain, Tourism Manage. **25**, 623–636 (2004)
7. Bramwell, R.: consumer behavior in travel and tourism, published by Howarth Hospitality press, ISBN: 0-7890-0610-3 (1996)
8. Madanipoor, A.: designing the city of reason. Published by Routledge, ISBN: 0-203-96213-39 (2007)
9. Khirfan., (Re)branding Amman, A.: lived city's values, image and identity, Macmillan Publishers Ltd. 1751-8040 Place Branding and Public Diplomacy **9**(1), 49–65 (2012)
10. Dinnie, K.: City Branding; Theory and Cases. First published 2011 by Palgrave Macmillan (2011)
11. Malcolm, M.: Cities and Cultures, First published 2007 by Routledge 2 Park Square, Milton Park, Abingdon, Oxon OX14 4RN, ISBN 0-203-00109-5 Master e-book ISBN (2007)
12. Hankinson, G.: The management of destination brands: five guiding principles based on recent developments in corporate branding strategy. J. Brand Manage (2006)
13. Helmi, M.: Urban branding strategies and the emerging Arab cityscape: The image of the Gulf city. Kairo: Stattgart univ (2008)
14. Govers, R.: Place branding. glocal, virtual and physical identities, constructed, imagined and experienced. Published by Palgrave Macmillan. ISBN: 9780230230736 (2009)
15. Bentley,I.: Responsive Environment. Publisher, Oxford: Architectural Press: Butterworth-Heinemann (1996)
16. Hankinson, P, Hankinson, G.: Managing successful brands: an empirical study which compares the corporate cultures of companies managing the world's top 100 brands with those managing outsider brands, J. Mark. Manage. **15**(1-3), 135–55 (1999)
17. Kotler, P., Asplund, C., Rein, I.: Marketing Places Europe. Prentice Hall (1999)

Psychic Distance, Purchase Intention and Life Satisfaction. An Analyzing of International Purchase Websites

Mauro José de Oliverira, Rodrigo Martins Bapitsta and José Manuel Baptista Meireles de Sousa

Abstract The e-commerce through international shop web-sites has gaining more space around the world. The study this phenomenon is still under development. In this work, we contribute to the literature extending and testing an existing conceptual model in a new scenario. It was included the independent variable to explain: Life Satisfaction, Purchase Intention and the Psychic Distance in using international shopping sites. An online survey of university students (n = 211) was performed. Our structural equation model revealed that Life Satisfaction influences Purchase Intent and Psychic Distance, when mediated Interactivity, Informativeness and Convenience of Use. Our results reveal a new approach among the factors that influence these constructs.

Keywords Psychic distance · Purchase intention · Life satisfaction

1 Introduction

According to [1] the on-line trade in the world represents 10 % of trades between businesses and consumers, i.e., US$ 1.2 trillion dollars. According to [2] among November and December 2014, 4 out of 10 Brazilians made purchases in international sites and in January 2014 were 3 out of 10.

The on-line Chinese web sites account was 55 % of total. The five most used sites are AliExpress, eBay, Amazon.com, DealExtreme and MiniInTheBox. The 20 most used websites, 12 are Chinese. The three categories most used in international sites for Brazilians are fashion and accessories, electronics and information technology.

M.J. de Oliverira
Centro Universitário Da FEI, R. Tamandaré, 688, São Paulo, SP, Brazil

R.M. Bapitsta · J.M.B.M. de Sousa (✉)
Universidade Anhembi Morumbi, R. Casa do Ator, 275, São Paulo, SP, Brazil
e-mail: jmbmsousa@anhembi.br

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E-commerce [3] can be defined as the buying and selling of information, products and services through computer networks. The information in international websites is often in other languages and sometimes the user needs to communicate and negotiate product conditions, payment and many other problems with delivery. Johanson and Vahlne [4] argued "the psychic distance is the sum of the factors that affect the flow of information between countries" in this context the user must interact with several variables in order to decrease of psychic distance with respect to international market. The psychic distance refers the individual's perception over the international business environment [5].

In this context, online social commerce, there were not many researches that discuss the perception of buyers of products/services international sites buying in Brazil and there are few studies on the nature of international purchase experience on websites.

This research aims to analyze characteristics international purchase websites may influence the import of goods and services, trust and moderate psychic distance. The influence of new variables factors were analyzed in a complementary model based in [6] as Life Satisfaction, Purchase Intention and Psychic Distance. The complete model studies the following variables: Life Satisfaction, Gender, Trust, Convenience of use, Informativeness, Interactivity, Purchase Intention and Psychic Distance.

2 Literature Review

2.1 E-commerce

E-commerce is understood as the buying and selling information, products and services through a network of computers [7]. According to [8], e-commerce refers trading in online network through integration between the company and the company—B2B and enterprise and consumer—B2C. For [9, 10], e-commerce is part of a broader business category, i.e., economic activities that make use electronic networks and technology platform have been termed electronic business. This expression encompasses the various types of commercial transactions, administrative and accounting, involving government, business and consumers. E-commerce is the main activity of this new business category [11].

E-commerce can reduce gap between buyer and seller, and thus allowing the rapid information exchange or service between buyer and sellers anywhere in the world [11]. The author reveals that e-commerce not only provides product options and services at a lower cost, but that can potentially allow more options to the needs of each buyer [12]. It seems relatively low cost to start any business through social networking sites, for example, Alibaba, Aliexpress and Amazon can act as a potential tool for online business, especially for access to large markets such as Brazil market [2].

2.2 Life Satisfaction

The life satisfaction has been studied with a central component of well-being. The definition of welfare is broad, subjective, multi-faceted and has cognitive and affective elements [13, 14]. Life satisfaction is a key indicator of subjective well-being [15] and can be defined as a process of comparison of the circumstances with what regarded as an adequate standard, or even an individual subjective assessment of how much needs, important goals and desires were satisfied [13]. That is, a cognitive evaluation of their overall life satisfaction [16, 17].

Life satisfaction is also considered subjective happiness and personal satisfaction and is determined in part by social ties of individuals [13, 18]. This concept is also associated with interpersonal communication and the global evaluation of the environment and can be positive or negative [16, 19]. It is also designed in part due to the satisfaction with the various areas of life such as work, family, health, etc., as well as happiness [20]. For example, feeling understood in trade relations between Asian and Anglo-Saxons have a positive effect on life satisfaction even with striking cultural differences [21–23].

2.3 Interactivity

Interactivity is one of most important features in social networking service. Despite receiving information unilaterally, a social networking service allows users to communicate with each other. [24, 25]. Describe when a user seeks a website it not only search some information, but interactivity and ease of navigation. The author reveals that having ease navigation it contributes for gathering information. In other words, it avoids noise and keeps the user's concentration on webpage. That is, a site does not deliver these conditions take a risk to be avoided by users in the future. Yen and Chenn [26] revels interactivity is also related to the quality of the site, that is, playful elements, connectivity, and reciprocal communication. Oliveira and Huertas [10], Lee [24] show interaction leads for relationship of training, which leads to the deepening of the relationship—identifying and ultimately brand loyalty. Other researches has shown that interactivity affects confidence in case online travel community [27–30].

2.4 Informativeness

The information search is defined as a process in which human beings deliberately make an effort to change your state of knowledge [24, 31, 32]. The search gradual way information increases the individual's knowledge repertoire and may contribute to better results [25, 33]. One of the biggest reasons to participate in social

networking service is information seeking [10, 19]. Other research shows that perceptions by others are formed through a direct interaction, that is, observation and/or third-party comments [34]. In this case, the informativeness highlights the fact that understanding of the information depends on the other information [25, 35, 36] say that informativeness is by sharing information interlocutors at all levels interpretations through the internet shopping [37–39].

2.5 Convenience of Use

Convenience of use or ease generally use refers to the ease use and search information [40]. The convenience of use is one of the reasons users choose an online shopping site on-line, as well as the quality of information.

There is research suggesting that perceived ease of use can actually be a causal antecedent to perceived usefulness. The quality of a shopping site on the Internet has positive correlation due to the behavior of individuals who wish to buy from international sites. In this way, the convenience can be an important criterion to be verified empirically since the impact can contribute to the increase of users purchase intention [41, 42].

2.6 Trust and Purchase Intention

According to [25], there are many factors affecting purchase intention on websites, including confidence in website and loyalty in an on-line purchasing community, which affects the intention to repurchase positively [24]. The sense of security due to confidence in on-line shopping has positive relationship with on-line purchase [40].

Many factors that affect trust in an on-line environment were studied in earlier research [29, 42, 43]. One was perceived reputation. Blogs realize that the company's reputation reported a positive result for the variable confidence [37]. The perceived reliability of these blogs could lead to a positive attitude on the part of companies selling products in domestic and international purchasing websites [4, 44].

2.7 Psychic Distance

Early research on the concept psychic distance occurred from the 1950s showing the perception remoteness and information and its consequences for international trade. In other words, business between the two countries was not studying only the physical aspect but also the dissimilarity as language, culture, relationships between

entrepreneurs, narratives, symbols and social values [5, 45]. The result factors that prevent or impede the flow of information between companies and the market is understood as the psychic distance [46]. Exporting companies in foreign markets face a managerial challenge not only to understand the customers and local marketing, but balancing multiple export relations interests through a large number of countries [47]. For [4], the psychic distance is defined, "the distance between the domestic market and foreign market, resulting from the perception of cultural differences and business." For [5, 48], companies engaged in international environment are negatively affected due to economic differences, political, social, cultural and language. In contrast, the study by reveals that the financial transactions of investments through online technology platforms can moderate the psychic distance and contribute to standardization, influence and the relationship between the company and consumer market. In this context, these results indicate the existence of a positive interaction effect influenced by financial transactions [6].

Life Satisfaction is considered a concept subjective happiness that can contribute to social interactions, information and convenience [13, 29]. Gender variable indicates the impact of greater reliance on the women than men [29]. Sites that underpin credibility and provide customer service has positive relationship with trust attitudes users on Internet, in other words, beliefs and attitudes of confidence can be affected by variations of shares the purchase sites online [37, 42]. Since the variable Convenience through fluidity and ease of finding product information, there is a positive relation to the perception of trust, that is, there is a perceived quality [40, 41]. The Informativeness can contribute to Confidence and Purchase intent [32, 39]. The results of the Purchase Intention can be positively affected by the quality of the interaction of the online shopping sites [38]. Johanson and Vahlne [4] revel that intended to carry out international business can be triggered and facilitated by adherence to the culture, language and the network. Purchase Intention has positive correlation with the degree of organization the information available on on-line sites, browsing speed on the site, but there is a negative relationship with levels of security of buying online sites [5]. Nevertheless, we still need to better understand to what extent the flow of information can interfere with the intention of buying. In this sense, the variable psychic distance can help better understand the positive effect of purchase intent. Studies have shown that the more the individual perceived cultural differences between his countries compared to the country abroad, the lower its intention to buy internationally. Other studies show that the higher the less ethnocentric consumer a chance to international purchase intent [43].

Hypothesis 1 Life Satisfaction has a positive effect on Interactivity. For [13] it has cognitive and affective elements and therefore relates to interactivity.

Hypothesis 2 Life Satisfaction has a positive effect on the informativeness. The variable satisfaction with life can help you get the quality of information for international orders online sites [18, 32].

Hypothesis 3 Satisfaction with Life has positive effect on the Convenience of Use. The ease use of online sites can be moderated by variable Satisfaction with Life [41].

Hypothesis 4 The Convenience of use has a positive effect on Purchase Intention. The ease of use online sites can change the purchase intention [41].

Hypothesis 5 Use the Convenience has a positive effect on confidence. Trust shapes by the use fluidity of sites online [37].

Hypothesis 6 The Informativeness has a positive effect on Confidence. The quality of information can moderate the confidence of users online sites [39].

Hypothesis 7 The Informativeness has a positive effect on Purchase Intention. Purchase Intention may increase if the quality of information [32].

Hypothesis 8 The Gender can influence positively the Trust. The male and female influences the confidence of individuals to international business [29].

Hypothesis 9 Interactivity has a positive effect on confidence. Reviews and quick responses can influence the trust of users [30].

Hypothesis 10 Interactivity has a positive effect on Purchase Intention. The user interaction in online sites can positively influence purchase intent [30].

Hypothesis 11 The Trust has a positive effect on Purchase Intention. The credibility and degree of trust can increase purchase intent of users [38, 42].

Hypothesis 12 The Purchase Intention has a positive effect on Psychic Distance. The distance from the international market can be amended by purchase intention [4, 40].

3 Methodology

We employed an online survey to collect empirical data. In developing our questionnaire, we applied the same measures as used in [25] of Interactivity, Convenience of Use, Informativeness and Trust as factors explaining the Purchase Intention. Also it used the Satisfaction with Life Scale and included the construct of Psychic Distance [4, 13] in the model.

The questionnaire was distributed to college students in Foreign Trade and International Commerce at the University Anhembi Morumbi, São Paulo, Brazil. The age of the respondents ranges from 18 to 30 years.

Data were collected between 13 and 25 April 2015. During this period, we received 211 valid responses, i.e., n = 211. The most respondents are women (58.3 %) than men (41.7 %) and all of them are students of higher education. According to official Brazilian government data, there are 34.1 million young

people between 15 and 24 years, i.e. 20.1 % of the total population, the majority of females (51.3 %), and 46.9 % have any occupation between 16 and 24 years.

With regard to expenses incurred, 46 % bought up to R$ 149.99 in international shopping websites, 45 % from R$ 150.00 to R$ 499.00 and 9 % over R$ 500.00. Regarding the frequency of purchases, 17.5 % made every two months, 27 % at least once a month and the majority less than once a month, or 45 %. Regarding the interaction with websites, only 22 % have habit of leaving comments on websites, most do not have this habit (36 %).

4 Data Analysis and Results

We use structural equation modeling (SEM) for data analysis because its capability in Analysing latent variables. The structural equation modeling (Structural Equation Modeling-no) is a statistical analysis in order to test hypotheses and relationships between the latent variables and observed [49]. PLS (Partial Least Squares) is based on the estimated minimum square partial with the primary objective of maximizing the explanation of the variance in dependent constructions of a structural equation model [50]. The software used was SmartPLS (Which uses component-based SEM techniques, named Partial Least Square structural equation modeling (PLS-SEM). PLS has several advantages over covariance-based SEM, for example, PLS-SEM performs well, When the data are not Normally distributed, like in ours, or When complex models with many indicators and relationships are estimated. PLS is well suited Also Particularly applied to settings where the emphasis is on predictive modeling [51]. Therefore, we used PLS-No to estimate the conceptual model. We Performed the analysis using SmartPLS 2.0 M3 [52]. Following [52], we computed the t-values using 5000 bootstrap samples to establish the significance value for each path coefficients. The minimum size of the sample was calculated using the G * Power 3.1.9 software [53]. The power of the statistical test was equal to 0.80 and the size the effect f2 = 0.15, the minimum established by [51]. Therefore, the minimum number of samples is 85. As [51] to have a more consistent model, the ideal sample should be double or triple that amount. In this article, this requirement is met, for n = 211 (Fig. 1).

Like in covariance-based SEM, we first test the reliability of the measurement model Followed by the structural model.

4.1 Assessment of the Measurement Model

We first evaluated the measurement model by examining the item loading, composite reliability, convergent validity, and discriminant validity. Most of the item loadings are above the recommended 0.7 [52] with a few exceptions which are lower than 0.7 were removed from further analysis (Use4, PD1, INT3, LS5 and Pi4,

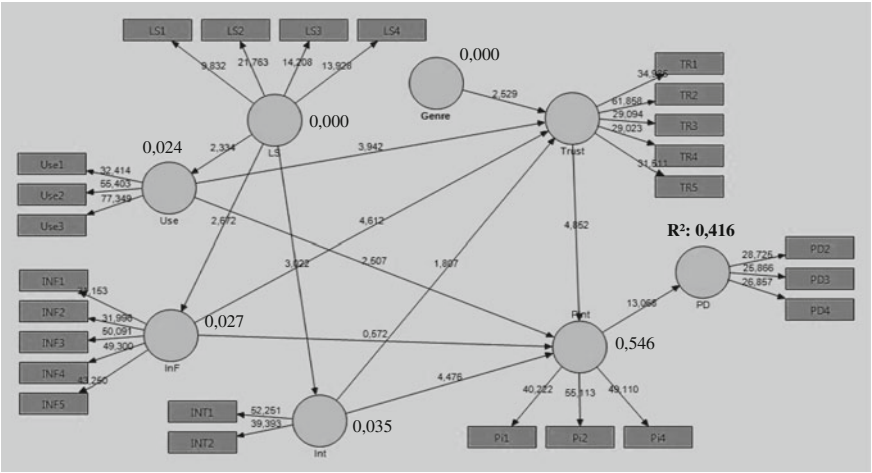


Fig. 1 Structural model results. Note: Path coefficients: ***Significant $p < 0.001$, **$p < 0.05$, *$p < 0.10$. Imagem gerada pelo software SmartPLS

shown in italic). All factor loadings are significant, and the composite reliability (CR) exceeds the recommended level of 0.7, and the average variance extracted (AVE) values are above the recommended level of 0.5 [52].

All the item loadings on their respective construct are greater than their loadings on other constructs, we then compared the square roots of the AVE with the latent variable correlations, and the results show good discriminant validity (Appendix):

Table 1 Results of the structural model ($R^2 = 0.42$)

	Coefficient	t-value	Hypotheses	Conclusion
LS → INT	0.187	3022***	H1	Supported
LS → INF	0.165	2672***	H2	Supported
LS → Use	0.156	2334**	H3	Supported
Use → Pi	0.201	2507**	H4	Supported
Use → Trust	0.270	3942***	H5	Supported
INF → Trust	0.362	4612***	H6	Supported
INF → Pi	0.038	0.572	H7	NS
Genre → Trust	0.130	2529**	H8	Supported
INT → Trust	0.126	1807*	H9	Supported
INT → Pi	0.294	4476***	H10	Supported
Trust → Pi	0.352	4852***	H11	Supported
Pi → PD	0.645	13,068***	H12	Supported

Note
*$p < 0.10$
**$p < 0.05$
***$p < 0.01$

all square roots of AVE are larger than the correlations between every pair of latent variables.

Table 1 shows the results of the PLS structural model with the estimated path coefficients and the associated t-values of the paths. The model accounts for 42 % of the variation in Psychic Distance.

5 Conclusions

An important variable added to this model was gender. There was a positive correlation between male and female for the variable trust in this case corporate international sites shopping online can establish ways to communicate their products specifically for men and women, as sex can contribute to increased confidence. Studies [29] (Wright and Sharp [29]) revealed that women have greater impact confidence than men.

The Interactiveness increases the variable Trust—good sources of product information and how online sites moderate the exchange of buyer and seller information can help in confidence [25, 38]. For example, users of international online sites need well understand the international shipping conditions, delivery time and ways of monitoring the goods outside of Brazil. The Interactiveness can enhance the user's purchase intention precisely because the information exchanged through sites are fast and sometimes the site features translation resources on the user's own language—for example, websites as Amazon, E-bay and Aliexpress.

The variable Trust has positive relationship with Purchase Intention, namely credibility, reliability increases will you deal with possible uncertainties in the international online environment and contributes to the purchase intention.

The variable Purchase Intention has positive relationship with Psychic Distance. The degree of international buyer uncertainty is moderated positively by the variable Purchase Intention. In this sense, the language barrier difference, culture difference, a different economy may be mediated by purchase intention when international on-line websites are the means used.

Among limitations of the current research, the concentration on international purchase websites and students is the first one, thus results cannot be generalized to all international purchase websites purchase intention. The sample has participants from International Trade, International Relations and Management students (N = 211). Nevertheless, their demographic and psychographic characteristics are quite similar among participants. For this reason, additional analyses considering differences in factors like the other regions in Brazil and age group.

Our structural equation model revealed that Life Satisfaction influences Purchase Intention and Psychic Distance, when mediated Interativeness, Informativeness and Convenience of Use. Our results reveal a new approach among the factors that influence these constructs.

Appendix: Latent Variable Correlations and Square Roots of AVE

Notes: Boldface numbers are loadings of indicators to their own construct; other numbers are the cross loadings.

	Genre	INF	INT	LS	PD	Pi	Trust	Use
Genre	**1**							
INF	0.12	**0.86**						
INT	0.14	0.53	**0.90**					
LS	0.11	0.17	0.19	**0.85**				
PD	0.05	0.44	0.52	0.18	**0.84**			
Pi	0.09	0.54	0.61	0.17	0.64	**0.89**		
Trust	0.22	0.62	0.50	0.07	0.44	0.64	**0.84**	
Use	0.12	0.63	0.59	0.16	0.48	0.60	0.59	**0.89**

Notes Boldface numbers on the diagonal are the square root of the AVE for each construct

References

1. WTO: E-commerce in Developing Countries. Opportunities and Challenges for Small and Medium Sized Enterprises. Genebra (2013)
2. E-BIT: WEBSHOPPERS 2015. São Paulo (2015)
3. Kalakota, R., Whinston, A.: Frontiers of Electronic Commerce. Addson-Wesley, New York (1996)
4. Johanson, J., Vahlne, J.: Business relationship commitment and learning in the internationalization process. J. Int. Entrepreneurship **46**(2), 83–101 (2003)
5. Johanson, J., Vahlne, J.E.: The Uppsala internationalization process model revisited: from liability of foreignness to liability of outsidership. J. Int. Bus. Stud. **40**(2), 1411–1431 (2009)
6. Sousa, C.M.P., Bradley, F.: Cultural distance and psychic distance: two peas in a pod. J. Int. Mark. **14**(1), 49–70 (2006)
7. Srinivasan, S.S., Anderson, R., Ponnavolu, K.: Customer loyalty in e-commerce: an exploration of its antecedents and consequences. J. Retail. **78**, 41–50 (2002)
8. OCDE: Empowering E-consumers. Strengthening Consumer Protection in the Internet Economy. Organisation for Economic Co-operation and Development. http://www.oecd.org/ict/econsumerconference/44047583.pdf (2009)
9. Takahashi, T.: Sociedade da informação no Brasil. M. d. C. e. Tecnologia, Brasília (2000)
10. Oliveira, M.J., Huertas, M.K.Z.: Does life satisfaction influence the intention (We-Intention) to use Facebook? Comput. Human Behav. **50**, 205–210 (2015)
11. Nath, P.: E-commerce: socio-economy impact. Online J. Humanit. Soc. Sci. **1**(4), 223–229 (2013)
12. Slywotzky, A.J.: The future of commerce. Harvard Bus. Rev. (2000)
13. Diener, E., et al.: The satisfaction with life scale. J. Pers. Assess. **49**(1), 71–75 (1985)
14. Sirgy, M., et al.: The quality-of-life (Qol) research movement: past, present, and future. Soc. Indic. Res. **76**(3), 343–466 (2006)

15. Erdogan, B., et al.: Whistle while you work: a review of the life satisfaction literature. J. Manage. **31**(4), 1038–1083 (2012)
16. Diener, E., Sandvik, E., Pavot, W.: Happiness is the frequency, not the intensity of positive versus negative affect. In: Strack, F.E., Argyle, M.E., Schwarz, N.E. (eds.) Subjective Well-Being: An Interdisciplinary Perspective, Pergamon Press (1991)
17. Frisch, M.B., et al.: Clinical validation of the quality of life inventory: a measure of life satisfaction for use in treatment planning and outcome assessment. psychological assesment. J. Consult. Clin. Psychol. **4**, 92–101 (1992)
18. Kahneman, D., Krueger, A.B.: Developments in the measurement of subjective well-being. J. Econ. Perspect. **20**(1), 3–24 (2006)
19. Scheufele, D.A., Shah, D.V.: Personality strength and social capital: the role of dispositional and informational variables in the production of civic participation. Commun. Res. **27**, 107–131 (2000)
20. Rode, J.C.: Job satisfaction and life satisfaction revisited: a longitudinal test of an integrated model. Human Relat. **57**(9), 1205–1230 (2004)
21. Ozmete, E.: Subjective well-being: a research on life satisfaction as cognitive component of subjective well-being. Int. J. Acad. Res. **3**(4), 55–61 (2011)
22. Dyrdal, G.M., et al.: Can a happy relationship predict a happy life? A population-based study of maternal well-being during the life transition of pregnancy, infancy, and toddlerhood. J. Happiness Stud. **12**(6), 947–962 (2011)
23. Oishi, S., et al.: Feeling understood as a key to cultural differences in life satisfaction. J. Res. Pers. **47**, 488–491 (2013)
24. Lee, J.: A study on the structural relationship of interaction, identification, and loyalty of online brand community in China. Digital Policy Manage. **10**(11), 235–241 (2012)
25. Han, M.C.: How social network characteristics affect users' trust and purchase intention. Int. J. Bus. Manage. **9**(8), 1833–8119 (2014)
26. Yen, D., Chenn, K.: Improving the quality of on-line presence through interactivity. Inf. Manage. **42**(1), 217–226 (2004)
27. Wu, J.J., Cheng, Y.S.: Towards understanding members' interactivity, trust, and flow in online travel community. Ind. Manage. Data Syst. **105**(7), 937–954 (2005)
28. Liu, Y.: Developing a scale to measure the interactivity of websites. J. Advertising Res. **43**(2), 207–216 (2003)
29. Wright, T., Sharp, E.: Content and grammatical sex bias on the interpersonal trust scale and differential trust toward women and men. J. Consult. Clin. Psychol. **47**, 72–85 (1979)
30. Novak, T.P., Hoffman, D., Yung, Y.: Measuring the customer experience in online environments: a structural modeling approach. Mark. Sci. **19**(1), 22–42 (2000)
31. Lara, M.L.G.: Informação, Informatividade e Lingüística Documentária: Alguns Paralelos Com Reflexões de Hjorlando E Capurro. Revista de Ciência da Informação **9**(6), 20–27 (2008)
32. Chob, C.H., Robertsb, M.S.: Internet uses and gratifications: a structural equation model of interactive advertising. J. Advertising **34**(2), 57–70 (2005)
33. Tan, X., et al.: Impact of privacy concern in social networking web sites. Internet Res. **22**(2), 211–233 (2012)
34. Borgatti, S., Cross, R.: A relational view of information seeking and learning in social networks. Manage. Sci. **49**(4), 432–445 (2003)
35. Li, H., Suomi, R.: a proposed scale for measuring e-service quality. Int. J. U-And E-Service Sci. Technol. **2**(1), 1–10 (2009)
36. Koh, J., Kim, Y.G.: Knowledge sharing in virtual communities: an e-business perspective. Expert Syst. Appl. **26**(2), 155–166 (2004)
37. Bracket, L.K., Carr, B.N.: Cyberspace advertising vs. other media: consumer vs. mature student attitudes. J. Advertising Res. **41**(5), 23–32 (2001)
38. Coviello, N.E., Munro, H.: Network relationships and the internationalisation process of small software firms. Int. Bus. Rev. **6**, 361–386 (1997)
39. Ducoffe, R.H.: Advertising value and advertising on the web. J. Advertising Res. **5**, 36 (1996)

40. Yoo, B., Donthu, N.: Developing a scale to measure the perceived quality of an internet shopping site. Q. J. Electron. Commer. **2**(1), 31–47 (2001)
41. Davis, F.D., Bagozzi, R.P., Warshaw, P.R.: User acceptance of computer technology: a comparison of two theoretical models. Manage. Sci. **35**, 982–1003 (1989)
42. Gefen, D., Straub, D.W.: Consumer trust in B2C e-Commerce and the importance of social presence: experiments in e-Products and e-Services. Omega **32**(6), 407–424 (2004)
43. Shimp, T.A., Sharma, S.: Consumer ethnocentrism: construction and validation of the cetscale. J. Mark. Res. **24**(3), 280–289 (1987)
44. Yun, H., Ahn, S., Lee, C.: Determinants of trust in power blogs and their effect on purchase intention. J. Korea Contents Assoc. **12**(2), 411–418 (2012)
45. Barkema, H.G., Bell, J.H.G., Pennings, J.M.: Foreign entry, cultural barriers and learning. Strateg. Manage. J. **17**, 151–166 (1996)
46. Evans, J., Mavondo, F.T.: Psychic distance and organizational performance: an empirical examination of international retailing operations. J. Int. Bus. Stud. **33**(3), 515–532 (2002)
47. Griffith, D.A., et al.: Marketing process adaptation. Antecedent factors and new product performance implications in export markets. Int. Mark. Rev. **31**(3), 308–334 (2013)
48. Griffith, D.A., Myers, M.B.: The performance implications of strategic fit of relational norm governance strategies in global supply chain relationships. J. Int. Bus. Stud. **36**(3), 254–269 (2005)
49. Gosling, M., Gonçalves, C.A.: Modelagem Por Equações Estruturais: Conceitos e Aplicações. Revista de Administração Faces Journal **2**(2), 83–95 (2003)
50. Henseler, J., Ringle, C.M., Sinkovics, R.R.: The use of partial least squares path modeling in international marketing. Adv. Int. Mark. **20**, 277–319 (2009)
51. Hair, J.F., et al.: Primer On Partial Least Squares Structural Equation Modeling (PLS-Sem). Sage, Los Angeles (2014)
52. Hair, J., Ringle, C., Sarstedt, M.: PLS-Sem indeed a silver bullet. J. Mark. Theor. Pract. **19**(2), 139–151 (2011)
53. Faul, F., et al.: Statistical power analyses using G*Power 3.1: tests for correlation and regression analyses. Behav. Res. Methods **41**, 1149–1160 (2009)

Part XI
Training Applications in Military and Operational Environments

Interpretative Phenomenological Analysis for Military Tactics Instruction

Michael W. Boyce, Deeja Cruz and Robert Sottilare

Abstract This experiment determined how 19 Army Reserve Officer Training Corps (ROTC) cadets rationalize military tactics decisions using two different displays through qualitative data analysis. Interpretative Phenomenological Analysis (IPA) was used to understand platoon and squad level decision-making to help influence the development of adaptive training systems. IPA is a process through which the participant experience is analyzed through a dual interpretation methodology, where participants provide meaning of their world, followed by an empirical assessment to categorize and define the participants' perspectives of their experiences. The tactical questions covered topics that would typically be covered in a military science junior level class. Results include the importance of terrain elevation differences between friendly and enemy forces, as well as the importance of cover and concealment and distance. The findings from this experiment are currently being developed into a large scale assessment in collaboration with the United States Military Academy at West Point.

Keywords Interpretative phenomenological analysis · Military population · Qualitative research · Experiential learning · Decision-making

1 Introduction

Interpretative Phenomenological Analysis (IPA) is a qualitative research approach that explores an experience from the participant's perspective [1]. Although much of the work using IPA has occurred within in the healthcare domain [2], performing

M.W. Boyce (✉) · D. Cruz · R. Sottilare
Army Research Laboratory, 12423 Research Parkway, Orlando, FL 32826, USA
e-mail: michael.w.boyce11.ctr@mail.mil

D. Cruz
e-mail: deeja.e.cruz.ctr@mail.mil

R. Sottilare
e-mail: robert.a.sottilare.civ@mail.mil

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a detailed analysis of someone's experience can be valuable in an applied setting such as military tactics decision-making. Military decisions are often characterized by complex environments and parameters, and the ability to understand how individuals process information within these environments is beneficial [3]. IPA attempts to replicate the participant's sense-making processes, considering both context and social factors important to the participant. Smith [4] developed IPA as a qualitative research approach, consisting of a combination of three philosophical approaches: phenomenology (identifying the distinguishable aspects of an experience), hermeneutics (an attempt to view the experience from the perspective of the participant and understand why it is meaningful to them), and idiography (the focus of detailed analysis of each individual case before expanding to overarching statements) [5, 6].

This research project focused on developing a qualitative understanding of the experiences of a group of Reserve Officers' Training Corps (ROTC) cadets. Although much of the human factors and ergonomics research in the military domain tends to focus on performance data, equally important is the ability to understand the experience of training through the eyes of those participants. Qualitative research can assist in providing this component and has been used to assess military sexual trauma [7], looking at interviewees views on social conditions and violence after conflict had occurred [8], and looking at the effects of deployment on military marriages [9]. Although most of the research tends to focus in the healthcare domain [2], there has been research in other areas as well. IPA has been used to examine the effects of social factors, such as going on strike [10], or transitioning to motherhood [11]. It has also been used on the assessment of addictive gaming tendencies and how they altered the lives of gamers [12]. There has been research on cadet tactical intelligent trainers [13], but a gap exists in the literature for understanding military tactics decision-making that this research hopes to address.

Although IPA draws from philosophical approaches, it provides a methodological approach that can be applied by individuals who do not have a background in philosophy that are interested in collecting the experience of participants [1]. The interpretative part of the analysis can assist researchers in understanding what lies beneath the transcripts themselves to a more conceptual level, which aids in the understanding of what constraints or factors led to a particular response by a participant. This allows for the discovery of themes that might have otherwise gone unnoticed. Researchers then move from analyzing individual cases to examining common threads across all cases, which allows the researcher to flesh out more general themes and eventually identify higher level themes [1]. What made IPA especially applicable for this work was the research focus of how military cadets take the information that is presented to them, place it in context of both their existing knowledge and the parameters of the scenario, and construct meaning from that.

1.1 Study Background

The purpose of the research was to examine the differences in the ability to answer military tactics questions based on one of two presented displays. One display can be classified as a 2-D or flat display, similar to many military command and control displays. The other display was a 3-D perspective display where a projected map was overlaid onto a military sand table. This is part of a research testbed at the Army Research laboratory known as the Augmented REality Sandtable (ARES) [14]. In relation to IPA, the research questions were less focused on the individual display (as each participant was only exposed to one condition) and more along the lines of "What is the decision-making process for each individual cadet, and how does that decision-making process appear across multiple individuals?" Whereas most IPA studies occur in an interview format, this research focused around the explanations of each participant's answers to the tactical question and the map characteristics associated with the responses.

2 Method

Although there isn't a strictly prescriptive way to perform an IPA there are general process guidelines that this research used to guide the analysis process. For the purposes of this research Smith et al. [5] and Smith and Osborn [15] were utilized as a guiding framework. One of the common criticisms of IPA focuses on its psychological rigor. Opponents argue that it doesn't require any prescriptive process and it is simply descriptive. However, Larkin et al. [16] contend that while it might be different from other qualitative methodologies, it is not to be dismissed. What differentiates IPA is the methodical process and commitment to detail while maintaining the representative voice of the participant. Therefore, during this process the research team has worked hard to be as diligent and self checking as possible.

2.1 Step 1: Reading and Re-Reading

This step is important because it focuses on performing a close read of transcript content, thereby making sure that the researcher stays as close to the participant experience as possible. One of the downfalls of many IPA studies, however, is that they don't clearly bracket off any biases that the experimenter may have. This emphasizes Husserl's goal of understanding the experience and the way it occurs as it stands by itself [5], not necessarily how the researchers interpret it. So as a first step, a list was developed to understand what biases might be present, which are listed below:

- That the cadets will vocalize everything that is important to them. However it is possible that they process information in a way that skips steps along the process, thereby missing important decisions.
- That the displays presented are viewed as novel by the cadets. Being that most people have not seen a digitally augmented sand table, the assumption is made that this is new and they will not leverage prior experience. However, due to video-gaming or other potential interactions with technology, the cadets may not view this as novel. They could also classify it just as they would another military sand table, and build a mental model from that. This would reduce the novelty effect.
- That the cadets are not performing at an expert level, and will use the system to help facilitate their learning. It could be the case that, although they are cadets, they have achieved enough experience and proficiency to perform at an expert level. This would mean they would rely less on the system and more on their own raw intelligence and experience.

Out of a desire to try and gain as much information as possible the participants were both audio and video recorded. From that recording, transcripts were created according to participant and question number. Transcripts were taken as close to verbatim as possible, reviewing the recordings multiple times to verify phrasing by the participants.

2.2 Step 2: Initial Noting

Once all the transcripts were created, two independent coders (the first two authors of this paper), reviewed each of the transcripts and highlighted specific segments that were coded into 48 categories (for example there were categories discussing differences in elevation, visibility and techniques). Analysis was accomplished using both MAXQDA software (version 12, VERBI Software, Berlin, Germany) and Microsoft Excel. This step of the close reading of the transcripts involved focusing on the content and providing the foundation for interpretative comments associated with engaging the text [1]. It is this interpretative step that is tied to understanding Heidegger's emphasis on Dasein (i.e. taking everything in terms of its meaningful context) [16]. Below is a short excerpt from Participant 4 (P4) with the associated codes used by one of the coders (Table 1):

The coding for each participant was done using the existing 48 codes that were already created. If an additional code was discovered, it was added to the list. After finishing the individual transcript, the previously coded transcripts were revisited to see where the new code might be applicable. The new codes were also communicated daily between each rater, with a brief definition of what that code meant (without giving a specific example in the text). A running count was kept according to code by each rater. Each time a segment was discovered to fit within a category, it was added to a total count. When all the coding was complete, but prior to

Table 1 Example coding from single participant (P4)

Content	Coding
If your ORP [Objective Rally Point] is here, it looks like you could maneuver back behind a little bit, come down here, and then use this area of elevation as some covering, concealment, to maneuver toward the objective	Refers back to common practices
Whereas here you would be out in the open, coming in between these two areas. They would be able to see you	Desire to minimize visibility
Also these two would take way too long to go all the way over here and try to hit them from behind	Reference to time

resolving any discrepancies, the instances of each code were tabulated. The highest occurring instances are displayed below:

Once the initial codes were created, the two coders examined their individual codes for discrepancies. There were a total of 126 points of contention across the 19 participants with an average of 7 points of contention per participant. However this number is inflated because several of the points occurred more than once (most often due to a difference in interpretation of the meanings of the codes). Some of the more frequent codes with discrepancies included:

- Refers Back to Common Practices—This had 15 times where there was a discrepancy. Upon discussion, it was realized that this code needed to be more specific as to what was defined as a common practice. This code was updated to Forms of Maneuver, meaning this code provides a specific military term which has a particular set of actions associated with it.
- Awareness of Enemy Approach—This had 23 times where there was a discrepancy. Upon discussion, this code caused some confusion between the raters because it was unclear as to whether the code referred to predicted movement of the enemy or actual visibility of the enemy position. This code was updated to Prediction of Enemy Approach to reflect the researchers' interest in how the cadets used knowledge of the terrain to predict what the enemy was going to do next.
- Mention of Terrain Feature—This had 10 times where there was a discrepancy. The problem with this code was that it didn't provide a specific definition of a terrain feature. Therefore, this code was redefined as Identification of Terrain Feature. It was also decided that something would only be classified as a terrain feature if it was one of the 5 major/3 minor terrain features as defined by the Army FM 3-25.26 Map Reading and Land Navigation (Department of the Army, 2005).
- Hill for Cover—This had 11 times where there was a discrepancy. The confusion over this code was whether it referred to being on top of the hill, thereby a positive factor due to the higher elevation (delivering cover for others), or whether the hill was used as a defensive mechanism to shield friendly soldiers from enemy fire (staying behind a hill for cover). This was resolved by separating the two uses into separate codes. Providing cover using the hill was turned into Elevation Discrepancy Favors One Force. Behind the hill for defensive purposes was wrapped into Desire to Minimize Visibility.

Table 2 Reduced set of codes

Code	Description	Code	Description
1	Use of the phrase "mission dependency(ies)"	9	Unfamiliarity (use of any term that indicates lack of knowledge)
2	Avenue of withdraw	10	Mention of the word "road"
3	Debating between only two options	11	Minimization of risk
4	Desire to minimize distance	12	Prediction of enemy approach
5	Desire to minimize visibility	13	Reference to time
6	Identification of terrain feature	14	Relevance of waterways
7	Elevation discrepancy favors one force	15	Mention of fatigue
8	Forms of maneuver	16	Use of the phrase "line of sight"

After the issues with the codes were resolved, a second pass through the coding process was done by each coder. The emphasis this time was to be able to group various codes together to get to a second reduced set of codes (Table 2).

Once the initial and secondary codes were created, the next step was to verify the codes by examining the video recordings. Both researchers watched all of the video recordings together. Doing this allowed for the ability to check existing assumptions and verify that the words spoken in the transcript actually corresponded to what was coded.

2.3 Step 3: Developing Emergent Themes

As the team was reviewing the video footage, several common threads continued to emerge within and across the participants. See Table 3 for the list of emergent themes.

Minimizing Uncertainty is defined as the cadet making the decision to choose one option over another based on their knowledge of the enemy situation related to one of the positions. An example from the transcripts would be:

Table 3 Emergent themes

Code	Description	Code	Description
1	Minimizing uncertainty	5	Distance with respect to time
2	Minimizing visibility	6	Relevance of waterways
3	Distance with respect to spacing	7	Elevation with respect to height
4	Distance with respect to fatigue	8	Elevation with respect to advantage/disadvantage

> Just because I know that I just came from that area and I know that Charlie is a safe area to be… Alpha would be the second place I would pick but I think Charlie since all my guys just came from that area, that's where I would want to send them back for reorganization for following attack mission. [Participant 7]

Minimizing Visibility refers to the cadet choosing an option because it allowed them to stay hidden, thus avoiding detection by the enemy. An example is:

> It doesn't make sense to move from the ORP all the way down the trail and then come up because they can spot you right away along the trail. And it's kind of the same for B. [Participant 3]

Distance with Respect to Spacing refers to the cadet adjusting his or her planning due to being too close or too far away to make a given selection an ideal choice. For example:

> I would choose A because if the ORP is up here to the North, you'd have to move your whole element all the way around to the side and then come back up from the ORP, so I chose A just because it's going to get you up the closest. [Participant 8]

Distance with Respect to Fatigue refers to the cadet's consideration for the fatigue of the squad with which they were moving. Based on the concern of fatigue, they chose one option over another. An example from the transcripts follows:

> I chose A because like I said in the last question, it's the shortest distance to where you want to set up that support by fire, so that's a lot of weight the guys have to carry for support by fire, so this will give you, theoretically, more energy to conduct what they need to do. [Participant 1]

Distance with Respect to Time refers to the cadet making a decision based on how long it will take to cover a particular swath of terrain. An example would include:

> Any of these other three choices, B, C, or D, you have to move a longer distance behind the high ground here to put yourself back in the low ground, and then having to come back uphill to the high ground, whereas A you are coming to lower ground, but you're not going as far down. [Participant 1]

Relevance of Waterways refers to the consideration of waterways when the cadets are making their decisions. This could include both the use of and avoidance of waterways. An example would be:

> …I figured if they move this way it's a shorter distance, they hit water which they can use for supply, they're on a little bit of an area of elevation here, and some vegetation offering them cover and concealment… [Participant 4]

Elevation with Respect to Height reflects the cadet using elevation heights to determine which of the options to select. An example is as follows:

> …it looks like there is also a hill before reaching your objective, which could also give you an upper hand and kind of like getting some good visual of the objective prior to…rather than approaching it from another direction which you would have to literally climb up a hill in order to see the objective from distance… [Participant 13]

Elevation with Respect to Advantage/Disadvantage represented the cadet's awareness of how they positioned themselves in relationship to the enemy's position and how that provided a tactical impact for one side or the other. For example:

> I just looked at everything else and I think B, C and D give my troops a greater chance of being attacked or seen from further away. The enemy would have a better position on us. [Participant 7]

Together these themes helped to establish higher level meaning while at the same time holding true to the essence of what was in the transcripts.

2.4 Step 4: Searching for Connections Across Emergent Themes

This next step consisted of looking across the emergent themes to fit them together into a coherent story. To accomplish this, a process called abstraction was used. Abstraction looks for identifiable patterns and then uses those patterns to come up with "super-ordinate" themes [5]. Based on the eight emergent themes discussed above, three super-ordinate themes were created: Cover & Concealment, Distance, and Elevation Discrepancies.

Cover and Concealment had multiple aspects associated with it. Some individuals used cover and concealment as a means to minimize uncertainty, while others didn't specifically mention uncertainty but were concerned about visibility. Therefore those two categories (Minimization of Uncertainty and Minimization of Risk) were collapsed into the super-ordinate theme of Cover and Concealment.

Distance was represented in multiple ways. Cadets appeared to use distance as a part of their decision-making but prioritized aspects of distance differently. Some individuals made their decisions using distance as a measure of time. Others used distance in terms of the level of fatigue that it was going to cause their squad. Further, there were also situations where distance was a matter of spacing between themselves and the opposing forces. Therefore, the three distance-related emergent themes were collapsed into the super-ordinate theme of Distance.

Elevation Discrepancies indicated multiple relationships related to height differential (high/low, friendly/enemy, positive/negative), and the emergent themes of Elevation with Respect to Height and Elevation with Respect to Advantage/Disadvantage were collapsed into Elevation Discrepancies.

The only emergent theme that was not covered using these super-ordinate themes was Relevance of Waterways. It was decided to not fold this theme into the others because it didn't fit well with the existing structure. However, a fourth super-ordinate theme was later discovered, which will be discussed below.

3 Discussion

3.1 Cognitive Processing

After looking over the data, and considering the entire process, a fourth super-ordinate theme emerged. This theme was Cognitive Processing. After reading through the transcripts and notes several times, it was realized that the analysis was so focused on the soldier/tactical aspects that it missed considering the innate processes that occurred within the cadet, which they may have not been verbalizing. Upon further examination of cognitive processing, specifically comparing it with the initial 48 codes, it was decided that it could be broken up into three categories: Debating, Prediction, and Topographic Features.

- Debating was defined as a cadet moving through the potential answers and then verbally describing the rationale for each answer. Sometimes this was done with all four answers, and sometimes the cadet was able to eliminate two choices and then debate between the other two.
- Prediction was defined as the cadet making an estimate of what the enemy would do given the current situation. As a part of the assessment there were three questions that specifically asked to estimate what the cadet would do in the enemy's situation, which may have led to the prevalence of prediction.
- Topographic Features was defined as any natural feature that would cause the cadet to alter their decision. This category came up because of the emergent theme of Relevance of Waterways. Although waterways are not considered, in the traditional sense, a terrain feature, cadets consistently mentioned waterways from two different perspectives. At times they would use waterways to their advantage to do things such as resupply, while at other times they would avoid waterways as a part of their planning process.

This fourth super-ordinate theme provides an interesting perspective for research in that whenever a tactical scenario is under investigation, it will be a richer analysis if distinct cognitive factors are included. Given the opportunity, this will be included in future iterations of the project. What follows is a discussion of the three super-ordinate themes and how each relates to the teaching of military tactics.

3.2 Cover and Concealment

Being that this was a military tactical experiment, it is not surprising that cover and concealment was a major theme as the cadets were trying to minimize loss of life to their squad. Participant 4 mentioned cover and concealment and/or a desire to minimize visibility in the majority of his responses regardless of the tactical situation. In making his decisions, Participant 9 relied on cover and concealment as his primary deciding factor. Participant 9 discussed the use of terrain features but

placed them in context of how they support providing cover. He relied on this factor so much that he misses some of the correct decisions because they don't provide "sufficient cover." However, the importance of cover and concealment was surprisingly not universal. Participant 15's approach to making decisions was developed around the most direct routes to accomplish the specific tasks.

3.3 Distance

The most interesting thing about the distance theme is how different cadets conceptualized the important parameters associated with distance. Participant 4 discussed the relevance of speed and how quickly the soldiers can react either to accomplish an objective or to reorganize after a battle. Participant 8 approached the questions from an alternative angle, one which is focused on the heavy use of roads/trails. He is concerned about distance but more important to him appears to be the amount of time that it takes to achieve the particular maneuver or action. Participant 14 preferred choices that allowed her soldiers to attack the objective as quickly as possible and minimize the soldier fatigue.

3.4 Elevation Discrepancies

Elevation was a consistent topic throughout each stage of the IPA. Likewise, in just about every participant, decisions were made using elevation as a significant factor. Participant 1 demonstrated a strong concern for the effect of elevation on his tactical decisions. He specifically discussed how differences in elevation between himself and the opposing force led him to choose the answers that he did. Participant 5 emphasized his desire to use terrain elevation to put the enemy at a disadvantage. Participant 6 consistently mentioned his preference to have the higher ground and further clarified his reasoning for that by saying that the higher ground provided better visibility/line of sight. The effect of elevation was so prevalent that it warrants a specific study in itself. This study could analyze the different permutations of elevation, as well as examining different types of elevation cues and markings to help support cadet learning.

4 Conclusion

This paper discussed the use of IPA to support the examination of ROTC cadets' decision-making process for military tactics. The analysis yielded 48 initial codes describing factors that were important to the cadets. Those 48 codes were reduced to 16 codes on a second pass followed by a re-examination of video footage that

yielded eight emergent themes. The eight emergent themes were then collapsed to form three super-ordinate themes; Cover and Concealment, Distance, and Elevation Discrepancies. This study demonstrated that IPA can successfully be used to support analysis outside of the traditional healthcare domain and into the applied realm of military tactics.

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References

1. Shinebourne, P.: Interpretative phenomenological analysis. In: Frost, N. (ed.) Qualitative Research Methods in Psychology: Combining Core Approaches. Open University, pp. 44–65 (2011)
2. Brocki, J.M., Wearden, A.J.: A critical evaluation of the use of interpretative phenomenological analysis (IPA) in health psychology. Psychol. Health **21**(1), 87–108 (2006)
3. Goodwin, G., Johnston, J., Sottilare, R., Brawner, K., Sinatra, A., Graesser, A.: Individual Learner and Team Modeling for Adaptive Training and Education in Support of the US Army Learning Model: Research Outline (No. ARL-SR-0336). Army Research Laboratory, Aberdeen Proving Ground, MD. Human Research and Engineering Directorate (2015)
4. Smith, J.A.: Beyond the divide between cognition and discourse: using interpretative phenomenological analysis in health psychology. Psychol. Health **11**(2), 261–271 (1996)
5. Smith, J.A., Flowers, P., Larkin, M.: Interpretative Phenomenological Analysis: Theory. Method and Research. Sage, London (2009)
6. Pietkiewicz, I., Smith, J.A.: A practical guide to using interpretative phenomenological analysis in qualitative research psychology. Psychol. J. **20**(1), 7–14 (2014)
7. Turchik, J.A., McLean, C., Rafie, S., Hoyt, T., Rosen, C.S., Kimerling, R.: Perceived barriers to care and provider gender preferences among veteran men who have experienced military sexual trauma: a qualitative analysis. Psychol. Serv. **10**(2), 213 (2013)
8. Burgess, M., Ferguson, N., Hollywood, I.: Rebels' perspectives of the legacy of past violence and of the current peace in post-agreement northern Ireland: an interpretative phenomenological analysis. Polit. Psychol. **28**(1), 69–88 (2007)
9. Baptist, J.A., Amanor-Boadu, Y., Garrett, K., Goff, B.S.N., Collum, J., Gamble, P., Wick, S.: Military marriages: the aftermath of operation Iraqi freedom (OIF) and operation enduring freedom (OEF) deployments. Contemp. Fam. Ther. **33**(3), 199–214 (2011)
10. Brunsden, V., Hill, R.: Firefighters' experience of strike: an interpretative phenomenological analysis case study. Ir. J. Psychol. **30**(1–2), 99–115 (2009)
11. Smith, J.A.: Identity development during the transition to motherhood: an interpretative phenomenological analysis. J. Reprod. Infant Psychol. **17**, 281–300 (1999)
12. Chappell, D., Eatough, V., Davies, M.N., Griffiths, M.: EverQuest—It's just a computer game right? An interpretative phenomenological analysis of online gaming addiction. Int. J. Ment. Health Addict. **4**(3), 205–216 (2006)
13. Jensen, R., Presnell, B., Cobb, M.G., Lunsford, J., Kidd, D.: Generalizing Automated Assessment of Small Unit Tactical Decision Making. Stottler Henke Associates Inc., San Mateo (2013)

14. Amburn, C.R., Vey, N.L., Boyce, M.W., Mize, J.R.: The Augmented REality Sandtable (ARES). Technical Report. Army Research Laboratory, Aberdeen Proving Ground, MD. Human Research and Engineering Directorate (2015)
15. Smith, J.A., Osborn, M.: Interpretative phenomenological analysis. In: Smith, J.A. (ed.) Qualitative Psychology: A Practical Guide to Methods, 2nd edn. Sage, London (2008)
16. Larkin, M., Watts, S., Clifton, E.: Giving voice and making sense in interpretative phenomenological analysis. Qual. Res. Psychol. **3**(2), 102–120 (2006)

Exploring the Impact of Simulator Sickness on the Virtual World Experience

Crystal S. Maraj, Karla A. Badillo-Urquiola, Sushunova G. Martinez, Jonathan A. Stevens and Douglas B. Maxwell

Abstract This research initiative seeks to understand training effectiveness for Virtual World (VW) technologies. The advancement of VW training platforms in both academia and industry demonstrates the need to investigate the effects of simulator sickness (SS) on the VW experience. This paper uses the Military Open Simulator Enterprise Strategy (MOSES) VW platform to train 32 Reserve Officers' Training Corps Cadets from the University of Central Florida on a room clearing task. A between-subjects design was conducted with an emphasis on the VW training condition. The data collected included both individual and collective performance as well as perceptual data (SS, Presence, Flow, and Engagement). Data analysis comprised of a series of Pearson product correlation coefficient for understanding the relationship between SS and Presence, Flow, and Engagement in addition to explaining performance outcomes. The results found moderate to strong, negative correlations between SS and Presence, SS and Flow, and SS and Engagement. The results reveal that SS interrupts presence during the VW training which can lead to negative training transfer. Alternatively, the increase in presence, flow, and engagement associated with a decrease in SS may be linked to motivation which is essential to effective training. Finally, this paper discusses limitations related to VW research (e.g., internal and external validity, expertise level, etc.) but also provides a basic foundation from which SS research may enhance VW training.

Keywords Virtual environments · Virtual worlds · Simulator sickness · Pattern recognition

C.S. Maraj (✉) · K.A. Badillo-Urquiola · S.G. Martinez
The Institute for Simulation and Training, 3100 Research Parkway, Orlando, FL 32826, USA
e-mail: cmaraj@ist.ucf.edu

J.A. Stevens
The University of Central Florida, 4000 Central Florida Blvd, Orlando, FL 32816, USA

D.B. Maxwell
U.S. Army Research Laboratory, Orlando, FL 32826, USA

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1 Introduction

The Army Learning Concept for 2015 [1] provides a series of requirements for future training technologies that prepare Soldiers how to operate in ambiguous and unpredictable environments. The primary objective is to optimize the degree of training transfer to Soldiers with the migration of instruction from classroom-based instruction to blended learning (e.g., virtual simulations and game based environments). Traditional training environments require investing in personnel and typically have limited capabilities for distribution. Game-based virtual environments (GBVEs), however, are easily deployable systems and a low-cost alternative. Considering their variability of scenarios, GBVEs are considered viable solutions for distributed learning purposes. Unfortunately, there are still many limitations to GBVEs, such as limited resources for scenario content development. In addition, their complexity hinder instructors from restructuring predefined training sequences, thus limiting replication of dynamic operational environments [2, 3]. As a result, the Army Research Laboratory has developed the Military Open Simulator Enterprise Strategy (MOSES), an open source virtual world (VW) platform designed to facilitate a wide variety of training for Soldiers to strengthen their skillsets.

VWs allow users to self-pace their learning while simulating a sense of presence [4]. The scripting language in popular VWs, such as the MOSES environment, allows the instructor to develop objects, models, textures, and more for their scenarios. The persistent environment of VWs enables a large number of users to occupy the space at once [3]. This research paper seeks to assess the training effectiveness of emerging VW technologies. To gain a deeper understanding of VW technologies, the Kirkpatrick's [5, 6] Four-Level Training Evaluation Model (i.e., reaction, learning, behavior, and results) became the underlying framework for the Training Effectiveness Evaluation (TEE).

One by-product of utilizing VW technologies, is the increased potential to experience Simulator Sickness (SS) by individuals. Past research suggests that SS may have adverse effects on data, training, and influence dropout rates [7]. Further, the type of visual display employed may induce stronger reactions, such as the study conducted by Sharples et al. [8] where head mounted displays resulted in higher levels of SS compared to a desktop.

The Simulator Sickness Questionnaire (SSQ), was developed to assess symptoms experienced from visual display systems [9]. Specifically, the SSQ is comprised of nausea, oculomotor, and disorientation subscales used to explain the impact on performance. This research initiative focuses on the implications of SS on the virtual world experience. This paper examines the first two TEE factors: reaction and learning and its impact on the learners' perceptions and performance outcomes. To gain further insight into the performance outcomes, a closer examination of the relationships of SS with Presence, Flow and Engagement is explored.

2 Method

2.1 Participants

The participants included 32 U.S. Army Reserve Officers' Training Corps (ROTC) Cadets from the University of Central Florida (UCF), with ages ranging between 18 and 26 (M = 20.34, SD = 1.77). There were 25 males and 7 females. All participants were required to be U.S. citizens between the ages of 18 and 40, have normal or corrected to normal vision, and have full color vision. The participants were all considered novices, due to the lack of prior military experience in room clearing tasks, techniques, or procedures. Participants received no class credit or monetary compensation.

2.2 Experimental Design

This experiment employed a between-subjects design. The type of training condition received (i.e., traditional or virtual training) was the independent variable, and the dependent variables *measured* were individual and collective performance and survey data (i.e., SS, Presence, Flow, and Engagement). This paper narrowed its focus to the virtual world training condition to understand its impact and contributions to the VW experience.

2.3 Measurement Instrument

Participants were measured on their reported SS, Presence, Engagement, and Flow. Each of *these* was presented in survey form.

The Simulator Sickness Questionnaire (SSQ) measured physical symptoms (i.e. headache, fatigue, general discomfort, nausea, etc.) an individual experienced while using the Virtual Environment (VE). Participants rated these symptoms using a four-point scale rated as "None," "Slight," "Moderate," or "Severe."

The Presence questionnaire reported the participant's experience within an environment while physically located in another. The questionnaire comprised of several subscales including involvement and control, natural (interaction), resolution, and interface quality with 20 questions total and multiple questions for each subscale.

The Engagement questionnaire comprised of several subscales involving attentiveness, enthusiasm to complete the task, motivation to succeed, and improved concentration.

The Flow questionnaire examined the level of involvement the participant experienced while completing the task such that awareness of events or the passing

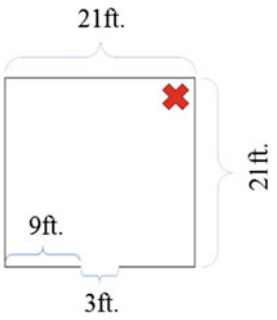


Fig. 1 Evaluation mock-up room layout

of time was reduced. Each participant was asked to rate their experience of flow (i.e., Action-Awareness Merging, Concentration on the Task at Hand, Sense of Control, etc.) using a five-point Likert scale.

2.4 Materials

The VW training occurred in the UCF Army ROTC Battle Lab. The lab contained 32 laptop computer workstations hosting the prototype MOSES VW training software for the participants to use. MOSES is a virtual world software application developed by the U.S. Army Research Laboratory, Human Research Engineering Directorate, Simulation and Training Center (ARL HRED STTC). There were also eight additional workstations for the experimenters to use to assist participants as necessary. A 21 ft. by 21 ft. mock-up room was also constructed inside an adjacent room for use in formal performance assessment of the room-clearing task. This structure had a 7 ft. by 3 ft. opening serving as the door (see Fig. 1).

2.5 Procedure

Upon arriving to the UCF Army ROTC Battle Lab, participants were organized into eight four-person fire teams and seated at their designated workstations. Each participant was given an informed consent document, asking for permission to be photographed and videotaped. Next, participants completed the demographics questionnaire. Then, a video demonstrating *the* room clearing task in the MOSES environment was presented. Based on U.S. Army doctrine, a subject matter expert delivered a supplemental block of instruction following the video. After training, there was approximately 15–20 min of practice time for each team to exercise the room clearing task in the MOSES virtual environment. Figure 2 presents a view of the environment. After practicing, each participant filled out the SS, Presence, Engagement, and Flow Questionnaires. Once completed, each team executed the



Fig. 2 Execution of the room-clearing task in MOSES

room clearing task twice and performance was assessed by the instructor. The task was performed in a mocked-up room (Fig. 1).

3 Results

Preliminary analyses were conducted to ensure no violations of assumptions of normality, linearity, and homoscedasticity were present in the data. A Pearson product-movement *correlation* coefficient was used to investigate the relationship between SS and Presence. Table 1 displays the significant outcomes found for SS and Presence.

There was a moderate, negative correlation between SS Nausea and Presence Resolution ($r = -0.471$, $n = 32$, $p < 0.01$), and Presence Interface Quality ($r = -0.461$, $n = 32$, $p < 0.01$). SS Oculomotor had a strong, negative correlation with Presence Resolution ($r = -0.504$, $n = 32$, $p < 0.01$) and Presence Interface Quality ($r = -0.563$, $n = 32$, $p < 0.01$). There was also a moderate, negative correlation between SS Disorientation and Presence Resolution ($r = -0.372$, $n = 32$, $p < 0.05$), and Presence Interface Quality ($r = -0.565$, $n = 32$, $p < 0.01$). Total SS and Presence Resolution ($r = -0.527$, $n = 32$, $p < 0.01$) had a strong, negative correlation, as well as Total SS and Presence Interface Quality ($r = -0.612$, $n = 32$, $p < 0.01$).

The relationship between SS and Flow was also investigated using a Pearson product-movement correlation coefficient. Table 2 presents the significant outcomes found for SS and Flow.

Table 1 Relationship between SS and presence

	Resolution	Interface quality
Nausea	−0.471**	−0.461**
Oculomotor	−0.504**	−0.563**
Disorientation	−0.372*	−0.565**
Total	−0.527**	−0.612**

**$p < 0.01$
*$p < 0.05$

Table 2 Relationship between SS and flow

	Action Awareness	Unambiguous feedback	Sense of control
Nausea	−0.473**	−0.549**	−0.429*
Oculomotor	−0.371*	−0.589**	−0.479**
Disorientation	−0.408*	−0.368*	−0.378*
Total	−0.458**	−0.599**	−0.503**

**$p < 0.01$
*$p < 0.05$

There was a moderate, negative correlation between SS Nausea and Flow Action Awareness Merging, ($r = -0.473$, $n = 32$, $p < 0.01$), and Flow Sense of Control ($r = -0.429$, $n = 32$, $p < 0.05$). SS Nausea also had a strong, negative correlation with Flow Unambiguous Feedback ($r = -0.549$, $n = 32$, $p < 0.01$). SS Oculomotor and Flow Action Awareness Merging ($r = -0.371$, $n = 32$, $p < 0.05$), and Flow Sense of Control ($r = -0.479$, $n = 32$, $p < 0.01$) had moderate, negative correlations, while SS Oculomotor and Flow Unambiguous Feedback ($r = -0.589$, $n = 32$, $p < 0.01$) had a strong, negative correlation. There was a moderate, negative correlation between SS Disorientation and Flow Action Awareness Merging, ($r = -0.408$, $n = 32$, $p < 0.05$), Flow Unambiguous Feedback, ($r = -0.368$, $n = 32$, $p < 0.05$), and Flow Sense of Control ($r = -0.378$, $n = 32$, $p < 0.05$). Total SS and Flow Action Awareness Merging had a moderate, negative correlation between ($r = -0.458$, $n = 32$, $p < 0.01$). Finally, there was a strong, negative correlation between Total SS and Flow Unambiguous Feedback ($r = -0.599$, $n = 32$, $p < 0.01$), and Flow Sense of Control ($r = -0.503$, $n = 32$, $p < 0.01$).

A Pearson product-movement correlation coefficient was also utilized to investigate the relationship between SS and Engagement. Table 3 provides significant outcomes.

There was a moderate, negative correlation between SS Oculomotor and Engagement ($r = -0.355$, $n = 32$, $p < 0.05$), with increased SS Oculomotor associated with decreased Engagement.

A series of multiple linear regressions were also conducted to predict SS on Presence and Flow. Results indicated that overall SS significantly predicted Presence's subscales Resolution ($\beta = 0.132$, $F(3, 28) = 3.712$, $p = 0.132$, R^2 adjusted = 0.208) and Interface Quality ($\beta = -0.704$, $F(3, 28) = 6.759$, $p = 0.041$, R^2 adjusted = 0.358). Additionally, the SS Nausea subscale significantly predicted

Table 3 Relationship between SS and engagement

	Engagement
Nausea	
Oculomotor	−0.355*
Disorientation	
Total	

**$p < 0.01$
*$p < 0.05$

Flow Clear Goals ($\beta = -0.678$, $F(3, 28) = 4.837$, $p = 0.040$, R^2 adjusted = 0.271). The results also indicated that SS significantly predicts Flow Unambiguous Feedback ($\beta = -0.685$, $F(3, 28) = 6.068$, $p = 0.051$, R^2 adjusted = 0.329) and Flow Sense of Control ($\beta = -0.564$, $F(3, 28) = 3.187$, $p = 0.140$, R^2 adjusted = 0.175).

4 Discussion

This paper specifically examined the relationship between an individual's SS and their experienced presence, flow and engagement. This paper serves as a foundational starting point for the aforementioned research objective, examining individuals' responses to the virtual treatment, which composes the first level (reaction criteria) of Kirkpatrick's model for evaluating the effectiveness of training.

The results were noteworthy. A significant, negative association between SS and Presence in the virtual environment was found. As an individual's sense of presence increased in the simulation, their corresponding degree of SS decreased. SS has been found to not only disrupt training but it has also been postulated that trainees will adopt coping behaviors to avoid SS, leading to the potential for negative transfer of training [7]. Therefore, the prevention of SS is of paramount importance to simulation practitioners, commanders, and the trainees themselves. The significant, negative relationship between Presence and SS may incentivize both simulation developers to design a higher degree of Presence in the simulation as well as simulation practitioners to create a higher degree of Presence in the actual training scenarios in order to avoid the SS phenomena.

There were also statistically significant negative correlations between both SS and Flow as well as SS and Engagement. Similar to Presence, as a Soldier's perceived sense of Flow and Engagement increased, their corresponding degree of SS decreased. These findings, similar to Presence, support the belief that higher perceptions of Flow and Engagement provide the benefit of decreasing SS, which should be a simulation trainer's goal. The corresponding decrease in SS leads to a more positive training perception and experience for the user. Another benefit of these observed associations is that all three factors positively increase an individual's motivation, arousal and willingness to train, which in turn may promote more effective learning. Thus, techniques that can be employed in simulation to increase Presence, Flow and Engagement should be pursued not only to improve the end-user's experience and decrease their level of SS in the simulation but also to promote the effective transfer of training.

Multiple regression analyses infer that both Presence and Flow moderately predicted the degree of SS experienced by the subject in this experiment. The linear combination of the Presence questionnaire subscales and various Flow questionnaire subscales were significantly related to the degree of SS experienced by the subject. Future research will be needed to in order to assess the relationship between these independent variables and SS.

5 Limitations

One of *the* limitations encountered during this study was the inability to acquire blank ammunition and real opposing forces (OPFOR) for the live assessment portion of this experiment. The lack of these training resources may have negatively affected both the face and external validity of the study. However, resource and safety constraints, coupled with campus security restrictions, prevented the use of these resources in the experiment. As such, face validity of the mock-up apparatus and live condition may have been subjectively viewed by participants as slightly artificial. In addition, external validity of the study may have not been optimal as the assessment condition may not have represented a realistic "run" phase of training without these resources. This may affect whether or not the future performance results are generalizable to the live environment.

Another limitation to the study may be the expertise level of the sample utilized. The sample was comprised of ROTC cadets in either their first or second year of cadet training. Therefore, this group of subjects had virtually no military experience in which to draw from. In contrast, the collective task used for this experiment, enter and clear a room, is perhaps one of the most advanced collective tasks found in the Army's training inventory. Based upon the above, a potential confounding variable may have been introduced whereby a very inexperienced group of subjects were inadvertently asked to perform a very advanced collective task. Further research will be required to determine the potential impact of this on the study's performance results.

6 Conclusion

The purpose of this research was to examine the efficacy of a virtual world simulation in the context of collective echelon military training. The research objective was accomplished by *executing* a series of data collection events, by collective echelon, which explored a virtual world simulation's effect on individual and collective performance. Based on the research findings in this paper, three recommendations are provided for the research community. First, future research should focus on investigating the impact of expertise on performance of the chosen task. Results may provide further insight into the results of this study. Second, incorporating higher degrees of Presence in the simulation may need to be explored to assess whether this change can prevent the SS. Lastly, future research on this topic may need to consider acquiring the necessary resources for maintaining both face and external validity.

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References

1. U.S. Army: The U.S. Army Learning Concept for 2015. Ft. Monroe, U.S. Army
2. Maraj, C., Lackey, S.J., Badillo-Urquiola, K.A., Ogreten, S.L., Maxwell, D.B.: Empirically derived recommendations for training novices using virtual worlds. In: Interservice/Industry Training, Simulation, and Education Conference, Orlando (2015)
3. Lackey, S.J., Salcedo, J.N., Matthews, G., Maxwell, D.B.: Virtual world room clearing: a study in training effectiveness. In: Interservice/Industry Training, Simulation, and Education Conference. Orlando (2014)
4. McLennan, K.: Using 3D virtual world models in e-economics instruction. In: 26th Annual Conference on Distance Teaching and Learning, pp. 1–5 (2010)
5. Kirkpatrick, D.L.: Techniques for evaluating training programs. Training Dev. J., 78–92 (1979)
6. Kirkpatrick, D.L., Kirkpatrick, J.D.: Evaluation Training Programs: The Four Levels. Barrett-Koehler Publishers, Inc., San Francisco (2006)
7. Brooks, J.O., Goodenough, R.R., Crisler, M.C., Klein, N.D., Alley, R.L., Koon, B.L., Logan, W.C., Ogle, J.H., Tyrrell, R.A., Wills. R.F.: Simulator sickness during driving simulation studies. Accid. Anal. Prev., 788–796 (2010)
8. Sharples, S., Cobb, S., Moody, A., Wilson, J.R.: Virtual reality induced symptoms and effects: comparison of head mounted display (HMD), desktop and projection display systems. Displays, 58–69 (2007)
9. Kennedy, R., Lane, K.R., Berbaum, L.N., Lilienthanl, M.: Simulator sickness questionnaire: an enhanced method for quantifying simulator sickness. Int. J. Aviat. Psychol. **3**(3), 203–220 (1993)

Behavior Cue Detection Training: Understanding the Impact of Simulator Sickness on Performance

Crystal S. Maraj, Karla A. Badillo-Urquiola, Stephanie J. Lackey and Irwin L. Hudson

Abstract In order to survive in combat zones, an individual soldier must be proficient in the following skills: Pattern recognition and Behavior cue detection. Although, current military training requirements are inadequate for developing pattern recognition and behavior detection, research shows that Simulation-based Training, via virtual environments (VE's) can improve pattern recognition and behavior detection skills. However, the use of VEs for visually dependent tasks may also increase simulator sickness in some individuals. This experiment compared a virtual version of Kim's game (i.e., an observational game to increase memory and performance) to a control group to assess the role of simulator sickness on performance. Participants were randomly assigned to either the Kim's game or control condition and completed a pre-test, training vignette, and post-test. During the experiment, participants recorded their level of simulator sickness using a questionnaire developed by Kennedy et al. (International Journal of Aviation Psychology 3:203–220, 1993 [1]). The data analysis revealed that the Kim's game group reported higher levels of simulator sickness symptoms which had a negative effect on performance (i.e., detection accuracy and false positive detection). The results also indicated that there was a positive correlation in the control group between disorientation and detection accuracy. This implies that the control group may have become familiar with the experimental task, suggesting that simulator sickness did not negatively impact their performance. The following paper dis-

C.S. Maraj (✉) · K.A. Badillo-Urquiola
Institute for Simulation and Training, Orlando, FL, USA
e-mail: cmaraj@ist.ucf.edu

K.A. Badillo-Urquiola
e-mail: kbadillo@ist.ucf.edu

S.J. Lackey
Design Interactive, Inc., Orlando, FL, USA
e-mail: Stephanie.lackey@di.com

I.L. Hudson
U.S. Army Research Laboratory, Adelphi, USA
e-mail: Irwin.l.hudson.civ@mail.mil

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cusses the influence of simulator sickness on performance and offers new ways to reduce simulator sickness for behavior cue detection training.

Keywords Kim's game · Simulation based training · Pattern recognition

1 Introduction

Pattern recognition training is a necessary asset for the Armed Forces, but training methods are currently limited due to declining military budgets [2]. Pattern recognition training is mostly used to improve decision accuracy, and the majority of the pattern recognition training is achieved in the operational environment [3]. This means that training to detect tactical patterns is very limited. This experiment utilized Kim's game, which is an observational game used for training in memorization and precise performance, to determine if it would increase pattern recognition ability in participants.

Where traditional training is limited, Simulation-Based Training (SBT) allows for adaptation and specialization of training. Traditional classroom-based training teaches the theory of improving skills, which can include "higher-order" skills (i.e. coordination, decision-making, etc.), and is then followed by a live training [4]. While the live training allows practice with actual equipment, it may also create dangerous situations that can result in injury. SBT "fills the gap" between classroom and live training with virtual training, which allows a more thorough understanding [5–7].

One way that behavior cue detection can be applied in the Military training domain is through combat profiling, which assesses change in human behavior while in a combat environment [8]. It involves the identification of behavioral cues into important patterns for individual interpretation [9]. Human behavior is determined via visual processing in a combative environment by using a combination of top-down and bottom-up processing. However, this process may not allow someone to become familiar with new terrain or people. It is in this way that improving visual processing can increase an individuals' ability to identify irregular behavior patterns.

Simulator sickness plays a very important role in determining the effectiveness of SBT, as the virtual environment (VE) can affect individuals in many different ways. Different frame rates and refresh rates have been known to induce symptoms of simulator sickness in people [10]. During this experiment, a simulator sickness questionnaire was used in order to assess the presence of any physical symptoms in participants, including general discomfort, headache, eye strain, etc. [1].

The purpose of this experiment was to investigate the use of SBT for enhancing pattern recognition skills, and to assess the effectiveness of simulation-based pattern recognition training on behavior cue detection by examining performance and perception data.

2 Method

2.1 Participants

75 participants were recruited from the University of Central Florida and the surrounding community. In total, there were 34 males and 41 females, with 36 participating in the Kim's Game group and 39 in the Control group. Upon arrival, participants were randomly assigned to a condition. Participants were required to be between 18 and 40 years of age (M = 22.072, SD = 3.75), have normal or corrected to normal vision, not be colorblind, and be U.S. Citizens. All participants were compensated with either monetary compensation ($10/h) or class credit (1 credit/hour) for up to 5 h.

2.2 Experimental Design

This experiment consisted of a between-subjects design with Kim's game as the one independent variable. The dependent variables measured were performance and survey data collected from the participants.

2.3 Measurement Instrument

Performance and survey data were measured with multiple subscales. Performance was determined based on detection accuracy (number of targets positively identified), false positive detection (identification of non-target models depicting a target behavior cue), response time (the amount of time taken for a participant to react to an event on the screen), and OSPAN (a series of math problems paired with a word recall task). Survey data was composed of a simulator sickness questionnaire that asked a series of 16 questions with a rating of 0-none and 3-severe for the severity of their symptoms.

2.4 Materials

Participants were taken to a room with a 22 in. desktop computer that contained Virtual Battlespace 2 (VBS2), which is used by the U.S. Army to create VEs for game-based training. It consists of an experimental terrain, virtual models, and a virtual camera. The image in Fig. 1 is an example of the terrain. The subjects in VBS2 were exhibiting various behavioral cues, from which participants are asked to

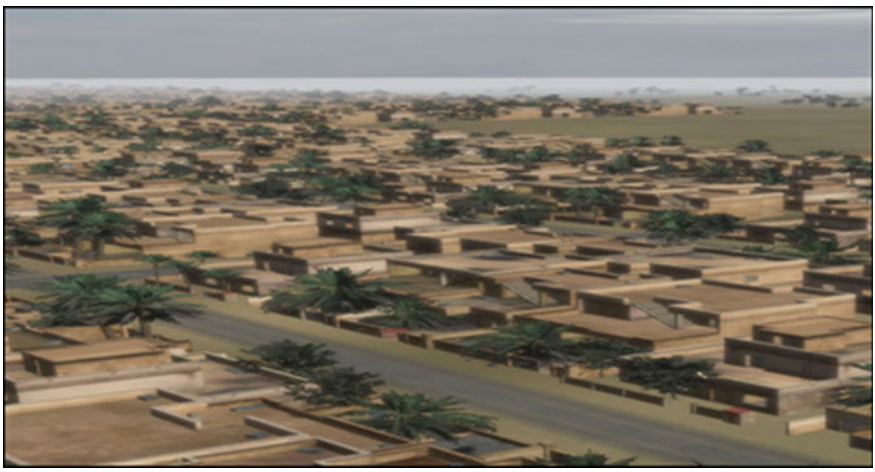


Fig. 1 VSB2 Testbed



Fig. 2 Kim's game scenario—Example of nervousness cue

identify aggressiveness and nervousness. Figure 2 provides examples of the 3D models exhibiting several behavioral cues.

2.5 Procedure

Participants were first given an informed consent to describe the risks and benefits associated with the task, which was then signed by both the participant and the experimenter. The experimenter asked pre-experimental questions and performed the Ishihara Test for Color Blindness. The interface training scenario followed, which gave the participant the opportunity to practice how to use the navigation and detection techniques in the environment. The participant was then given the pre-test. The pre-test lasted 40 min, and participants were asked to identify aggressive and nervous behavior in targets.

Table 1 Kim's game task layout

Event	Position A	Position B	Position C	Position D	Time (s)
Start time					1
1a	N	N	N	N	8
Blank screen					1
1b	T	N	N	N	8
End time					1
Change detected Y/N Yes: Click on Stimulus; No: Click No Change					20

The second interface training scenario included detecting changes in colored barrels (or determining if there was no change). Participants were then asked to complete the simulator sickness questionnaire and given a five minute break. After the break, they were presented with kinesic training slides, which gave examples of aggressive and nervous behavior (e.g., check-six behavior, slapping of the hands, etc.).

Following the training slides, the participants were given the 17-minute-long vignette, in which they were asked to identify changes in the targets' behavior. Below is an example of the task layout for Kim's Game. Finally, they completed the last Simulator Sickness Questionnaire (Table 1).

3 Results

A one-way between subjects ANOVA was conducted to compare the effect of simulator sickness on Post Practice Performance in the Kim's game and Control conditions. There was a significant effect of Nausea on post practice performance at the $p < 0.00$ level for the three conditions [$F(1, 73) = 223.16$, $p < 0.001$].

The relationship between simulator sickness and post-test performance was investigated using Pearson product-movement correlation coefficient. Preliminary analyses were performed to ensure no violations of assumptions of normality, linearity, and homoscedasticity. There was a weak negative correlation between oculomotor and detection accuracy ($r = -0.24$, $p < 0.05$) and a weak positive correlation between simulator sickness scales on Nausea and Oculomotor and false positive detection ($r = 0.25$, $p < 0.05$; $r = 0.27$, $p < 0.05$).

A multiple linear regression was used to examine simulator sickness as a predictor of post-test performance. The results of the linear regression indicated that simulator sickness accounted for 16 % of the variance for post-test detection accuracy ($R2 = 0.16$, $F\ (3,\ 71) = 4.64$, $p < 0.01$), specifically, Oculomotor ($\beta = 1.10$, $p < 0.01$) and Disorientation ($\beta = -0.68$, $p < 0.01$). Nausea ($\beta = 0.36$) was found to be the largest contributor to false positive detection. Oculomotor ($\beta = 0.27$) subscale was the largest contributor to response time. Further analysis of simulator sickness and Kim's game and control suggested Disorientation ($\beta = 1.01$,

$p < 0.01$) was a significant predictor for post-detection accuracy whereas Oculomotor ($\beta = 0.95$, $p < 0.05$) was a predictor for post-test false positive detection.

4 Discussion

The Kim's game group had higher reported levels of simulator sickness than the control group post practice, which could be due to the brains ability to process incoming visual information. During fixation, patterns of information are processed, and when fixation is redirected it focuses on observing specific activities in a scene [11]. The Kim's game and control groups were exposed to different video frame rates; Kim's game was presented at 30 hz, and the control was presented at 60 hz. Participants in the control condition saw clearer, more perceivable images that had smoother animations, which plays a large role in lessening simulator sickness [10]. Both groups experienced eye fatigue, blurred vision, and eye strain, but the Kim's game group reported higher levels.

High correlations between simulator sickness and post-test performance indicate that the nausea and oculomotor categories had a negative effect on detection accuracy and detection of false positives. This could be due to the training platform itself, as it is common for VEs to create discomfort in participants during experiments, or because of the length of exposure to the post-test [10, 12, 13]. According to previous research, 30 min is long enough to induce symptoms of simulator sickness, and the post-test given lasted for 40 min (to ensure greater experimental control and randomization).

Oculomotor and disorientation subscales were significant predictors of participant performance on the post test, indicating that the two drove detection accuracy performance. An increase in disorientation positively affected detection accuracy and oculomotor reported by the control group increased false positive detection. These results are counterintuitive, but can possibly be explained by a familiarization with the post-test in the control group.

5 Limitations

A potential limitation with this study is the fact that the conditions were presented at different video frame rates. The Control group scenario had a refresh rate of 60 hz, while the Kim's game group had a refresh rate half the speed. This means that participants in the control group had much clearer images and animations in their scenario than those in the Kim's game, which could lead to increased symptoms of simulator sickness, and effect performance.

6 Conclusion

Both the Kim's game and Control groups reported Simulator Sickness symptoms while exposed to the VE. This could be due to the VE platform itself, the refresh or frame rate of the scenario, or the scene content. There is a need to find different ways to mediate Simulator Sickness when using VE's for pattern recognition training. A possible way to improve the effectiveness of this technology is to increase the frame rates in the Kim's game scenarios.

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References

1. Kennedy, R.S., Lane, N.E., Berbaum, K.S., Lilienthal, M.G.: Simulator sickness questionnaire: an enhanced method for quantifying simulator sickness. Int. J. Aviat. Psychol. **3**(3), 203–220 (1993)
2. Department of Defense: Defense Budget Priorities and Choices Fiscal Year 2014. DOD (2013)
3. Fischer, S.C., Geiwetz, J.: Training Strategies for Tactical Pattern Recognition. United States Army Research Institute for the Behavioral and Social Sciences, Alexandria, Virginia (1996)
4. Spain, R.D., Priest, H.A., Murphy, J.S.: Current trends in adaptive training with military applications: an introduction. Mil. Psychol. **24**(2), 87 (2012)
5. Haque, S., Srinivasan, S.: A meta-analysis of the training effectiveness of virtual reality surgical simulators. IEEE Trans. Inf Technol. Biomed. **10**, 51–58 (2006)
6. Vogel-Walcutt, J.J., Gebrim, J.B., Bowers, C., Carper, T.M., Nicholson, D.: Cognitive load theory vs. constructivist approaches: which best leads to efficient, deep learning? J. Comput. Assist. Learn. **27**, 133–145 (2011)
7. Nicholson, D., Schatz, S., Bowers, C.: Developing Adaptive, Intelligent Scenarios to Support Enhanced Operations Training (2008)
8. Schatz, S., Reitz, E.A., Nicholson, D., Fautua, D.: Expanding combat hunter: the science and metrics of border hunter. In: The Interservice/Industry Training, Simulation & Education Conference (I/ITSEC), p. 10147. NTSA, Arlington, VA (2010)
9. Colombo, G., Dolletski-Lazar, R., Coxe, M., Tarr, R.: Setting the stage: preparation for advanced combat profiling training. In: Schatz, S., Nicholson, D., Fautua, D., Reitz, E. (ed.) The Interservice/Industry Training, Simulation & Education Conference (I/ITSEC). Orlando, FL (2012)
10. Kolasinski, E.M.: Simulator Sickness in Virtual Environments. Army Research Institute for the Behavioral and Social Sciences, Alexandria, VA (1995)

11. Henderson, J.M.: Human gaze control during real-world scene perception. Trends Cogn. Sci. **7** (11), 498–504 (2003)
12. Kennedy, R.S., Stanney, K.M., Compton, D.E., Jones, M.B.: Computerized methods to evaluate virtual environment aftereffects. In: Proceedings of DSC'99. Paris (1999)
13. McGee, M.K.: Using psychophysics to measure negative side effects in immersive virtual environments. In: Proceedings of the 42nd Human Factors and Ergonomics Society, pp. 1501–1505 (1998)

Part XII
Game-Based Learning

Game-Based Evacuation Drill Inside Google Street View

Hiroyuki Mitsuhara, Takehisa Inoue, Kenji Yamaguchi, Yasuichi Takechi, Mari Morimoto, Kazuhisa Iwaka, Yasunori Kozuki and Masami Shihibori

Abstract Evacuation drills should be conducted repeatedly in various conditions. Therefore, we have implemented game-based evacuation drill inside Google Street View (GSV) to realize evacuation drills in GSV with high situational (evacuation scenario) and visual realities (digital materials). In the evacuation drill, people can (1) participate easily and safely in evacuation drills regardless of time, place, weather, and their conditions, (2) participate in various evacuation drills for their local regions and other places, and (3) repeat the same evacuation drills with routes or behaviors that differ from their previous drills. We experimentally found that this type of evacuation drill has strong potential as a new evacuation drill.

Keywords Game-based learning · Evacuation drill · Virtual world · Google street view

1 Introduction

Natural disasters can occur at any time and location. According to a report released by a reinsurance company [1], the number of natural disasters has increased worldwide. A promising approach to disaster prevention (or mitigation) is disaster education. Therefore, disaster education should spread worldwide. While most people will not deny the importance of disaster education, many of them may be unwilling to receive disaster education because they believe that they will not be affected by a disaster. Accordingly, disaster education has not spread. We should

H. Mitsuhara (✉) · Y. Kozuki · M. Shihibori
Institute of Technology and Science, Tokushima University, 7708506 Tokushima, Japan
e-mail: mituhara@is.tokushima-u.ac.jp

T. Inoue · K. Yamaguchi · Y. Takechi · M. Morimoto
OPTPIA Co., Ltd., 7700052 Tokushima, Japan

K. Iwaka
Center for Community Revitalization, Tokushima University, 7708506 Tokushima, Japan

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change the present situation to protect ourselves against disasters. In other words, we require new disaster education techniques in order to change our mindset.

Currently, information and communications technology (ICT) plays an important role in disaster education. ICT-based disaster education is conducted actively in countries that have been damaged by large-scale disasters. For example, in Japan, Tobita et al. practiced disaster education using an all-around system that includes a geographic information system, hazard simulation, and a knowledge base [2]. Kobayashi et al. developed the Disaster Imagination Game system based on Tangible Bits technologies [3]. An international project called "Disaster Reduction Hyperbase" disseminates appropriate disaster risk reduction technology and knowledge through the Internet [4]. These systems can be considered examples of new disaster education.

We have focused on a digital game as promising ICT for disaster education. We have developed a game-based evacuation drill (GBED), which is realized as a location-based educational game in the real world [5]. The GBED system, which works on a tablet computer with a GPS receiver and other sensors, presents digital materials primarily based on a participant's current location and a branched evacuation scenario. Furthermore, the GBED system records evacuation logs (e.g., evacuation trajectory) and allows participants to visually reflect on their evacuation logs using Google Maps [6]. We conducted the GBED at several schools and determined through a questionnaire survey that it can improve student motivation for disaster prevention [7]. We also found that some participants (students) wished to perform the GBED in virtual worlds. To fulfill their wish, we have introduced Google Street View (GSV) into the GBED.

2 Game-Based Evacuation Drill

The GBED is disaster education through a story-based adventure game (or role-playing game) that combines the virtual (digital) and real worlds. In the GBED, digital materials that represent disaster situations (virtual disaster damage) corresponding to a participant's current location are presented on their tablet computer according to a branched evacuation scenario. Accordingly, the participant can simulate an evacuation by viewing the materials and real-world situations (e.g., scenery) and making decisions relative to the disaster situations.

2.1 Evacuation Scenario

Most participants will have difficulty imagining disaster situations without having experienced a real disaster. Disasters often cause moral dilemmas such as life-saving and safety-promoting actions that go against the principle of "a speedy escape." Difficult decisions that must be made between multiple moral choices are

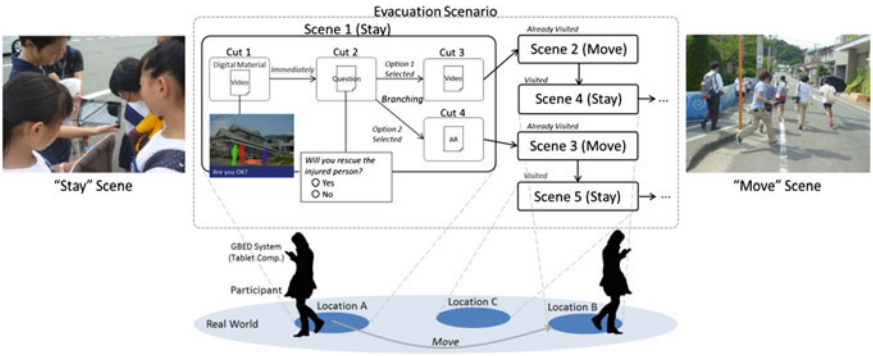


Fig. 1 Branched evacuation scenario with SSs, MSs, and cuts

often treated as subjects in game-based learning [8]. For example, if you encounter an injured person in the middle of an evacuation, will you help the injured person? Therefore, situational reality that includes moral dilemma must be considered in the evacuation scenario.

The evacuation scenario comprises scenes categorized as "stay" scenes (SS), "move" scenes (MS), and "interrupt" scenes (IS). Each SS corresponds to a location and comprises at least one cut (Fig. 1). MSs and ISs are independent of location and are conceptually located between SSs. The cut is the smallest unit used to present digital material. Branching conditions are primarily assessed at the end of every cut. Table 1 shows the main branching conditions, which can be considered game elements that make the GBED interactive.

Table 1 Main branching conditions

Condition	Explanation
Option selected	Relation: Cut - > Cut Every option in a single-choice question has a unique ID number. The next cut depends on which option a participant selects
Correct or wrong (or timeout)	Relation: Cut - > Cut This condition is set to a single-choice quiz question The next cut depends on whether a participant answers correctly
Already visited	Relation: Cut - > Cut, Cut - > MS The next cut/scene depends on which cut/scene a participant has visited in/up to the current scene
Visited	Relation: MS - > SS This condition is valid only for an MS where one or more SSs are the next scene candidates. When visiting one of the next scene locations, e.g., entering a squared area of the location, the learner moves to the next scene (SS)



Fig. 2 Example slideshow that represents a disaster situation

2.2 *Digital Material*

The digital materials (e.g., slideshows, videos, and single-choice questions) represent disaster situations by making the situations more realistic with audio-visual effects. In other words, audio-visual reality must be considered in the digital materials. For example, a slideshow that represents earthquake situations should visualize collapsed buildings, panicking people, ground liquefaction, and so on realistically with sounds (e.g., sirens and screams). Figure 2 shows an example slideshow. Single-choice questions can be used to ask participants about their behavior during disaster situations.

2.3 *Designing Evacuation Drill*

We have developed a web-based system for designing the GBED, which we refer to as "Bosai Yattosar"[1] (BY) [9]. The system allows users to author evacuation scenarios using a non-programing environment and upload or create digital materials. The users can create slideshows easily by combining component images, sounds, and subtitles that represent disaster situations. The evacuation scenario and digital materials are stored in the BY system.

[1]"Bosai Yattosar" means "Let's prevent disasters!" in Tokushima dialect (a regional dialect) in Japan.

3 Google Street View

Conventional evacuation drills are conducted to provide participants physical and perceptual experiences (e.g., tiredness and sense of evacuation time). The GBED aims at augmenting such experiences using evacuation scenarios (situational reality) and digital materials (audio-visual reality). However, these drills cannot be always conducted depending on weather or participant conditions. In addition, these drills should pay sufficient attention to safety, i.e., participants must be protected from all dangers (e.g., traffic accidents) because such problems are unavoidable problems in the real world.

3.1 Idea

We believe that evacuation drills should be conducted in the real world. In addition, evacuation drills should be conducted repeatedly in various conditions because disasters can occur at any time and place. Therefore, to realize the latter, we convert the GBED platform from the real world to a virtual world.

We have focused on GSV as the virtual world because it finely covers numerous streets in widespread areas of the world and displays a 360° realistic view. This means that participants can evacuate using a first-person perspective in the realistic virtual world by operating an avatar inside GSV using a web browser. We refer to the GBED inside GSV as "Googlevacuation." Googlevacuation has the following advantages.

- If people are in an Internet-enabled environment, they can participate easily and safely in evacuation drills regardless of time, place, weather, and their conditions.
- They can participate in various evacuation drills for their local area and other places (e.g., places they plan to visit) if there are many evacuation scenarios.
- They can repeat the same evacuation drills, attempting routes or behaviors (i.e., choices in single-choice questions) that differ from their previous drills.

3.2 Implementation and User Interfaces

We implemented Googlevacuation as a web application associated with the BY system. Figure 3 schematically shows the application. The client-side application, implemented using HTML5, JavaScript, and the Google Maps API, works as the viewer and controller. The server-side application, implemented using PHP and MySQL, works as the evacuation scenario converter. Googlevacuation is realized through the following transactions.

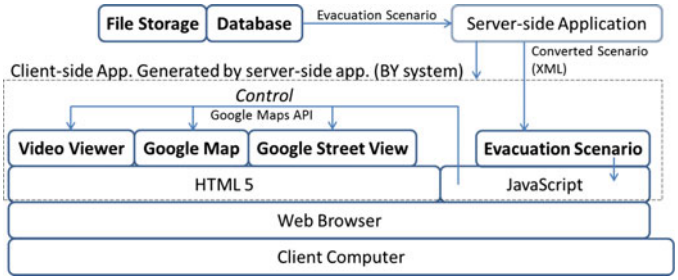


Fig. 3 Schematic composition of the Googlevacuation application

(i) A user selects an evacuation scenario stored in the BY system (server). The server-side application converts the evacuation scenario (data in the database) to a usable form (XML) for the client-side application.
(ii) The server-side application sends the converted scenario to the client-side application. Figure 4 shows an example of a converted evacuation scenario.
(iii) The client-side application receives the converted scenario and records it as arrays embedded in JavaScript.
(iv) The user begins evacuation from anywhere inside GSV and moves by clicking on arrows superimposed on the GSV (Fig. 5a). The client-side application tracks their current location and simultaneously refreshes GSV and the Google Map. Therefore, the user can see both the GSV world from a first-person perspective and their current location using the avatar (Pegman) on the Google Map.
(v) If the user enters an SS (i.e., a location designated in the evacuation scenario) in the GSV world, the client-side application presents the digital material (video) corresponding to the scene (Fig. 5b).[2]
(vi) After the scene ends, the client-side application indicates "Let's move!" to prompt the user to proceed to the next scene (i.e., an MS).
(vii) The user repeats (v) and (vi) until they enter an SS with the "end" property.

4 Experiment

GSV provides high visual reality for general use (e.g., recreation). However, in Googlevacuation, visual reality and experiential reality of evacuation should be considered. It is especially important to homologize evacuation time between the GBED (the real world) and Googlevacuation (the virtual world). If an evacuation is finished ahead of time, Googlevacuation participants may misjudge dangers in the

[2]Currently, the application cannot display slideshows and single-choice questions and therefore cannot deal with the "Option Selected" and "Correct or Wrong" branching conditions.

```
<scene no="9" type="stay" id="280">
  <name>Will you find your younger sister?</name>
  <condition sensor="gps">34.056357,134.283925,
34.056562,134.284194</condition>
  <cut no="1" id="762">
    <name>Younger sister missing</name>
    <content name="9-1" type="video">1612285602_9-1.mp4</content>
    <next condition="immediately">2</next>
  </cut>
  <cut no="2" id="763">
    <name>Decision</name>
    <message>Will you go back to the park to find her?</message>
    <content name="" type="ask" second="0">
      <option id="1">Yes</option>
      <option id="2">No</option>
    </content>
    <next condition="option_selected" option="1" value="1">3</next>
    <next condition="option_selected" option="2" value="2">4</next>
  </cut>
  <cut no="3" id="764">
    <name>I'll go back to the park.</name>
    <content name="9-3" type="video">1612284906_9-3.mp4</content>
    <next condition="end"/>
  </cut>
  <cut no="4" id="765">
    <name>I won't go back to the park. She must be OK.</name>
    <content name="9-4" type="video">1612284831_9-4.mp4</content>
    <next condition="end"/>
  </cut>
  <next condition="immediately">12</next>
</scene>
```

Fig. 4 Converted evacuation scenario (XLM)

evacuation and reduce their disaster prevention awareness. Therefore, we conducted a comparative experiment to assess the experiential reality.

4.1 Procedure

Participants. Twenty university students (age 18–24) were equally divided into two groups: Group A (GBED) and Group B (Googlevacuation). A starting location for the evacuation was commonly fixed for both groups.

Evacuation Scenario. An evacuation scenario that simulated an earthquake and required speedy escape to an evacuation building on their university campus was prepared. In this scenario, participants could select their paths; however, some paths to the evacuation building were blocked and the participants were forced to detour. Figure 6 shows the evacuation scenario as SSs overlaid on a map. In each scene,



Fig. 5 User interfaces of the Googlevacuation application (client-side application). **a** Moving inside GSV (i.e., an MS). **b** Viewing digital material (i.e., an SS)

videos were presented as digital materials. Regardless of the group, if participants visited the same scenes, the time required to view the videos was the same.

Questionnaires. Before the evacuation drill, the participants were asked about their estimated time for evacuation, "How many minutes do you estimate until you reach the evacuation building?" Immediately after the evacuation, they answered questionnaires (5-scale Likert) about reality, sense of tension, and other aspects.

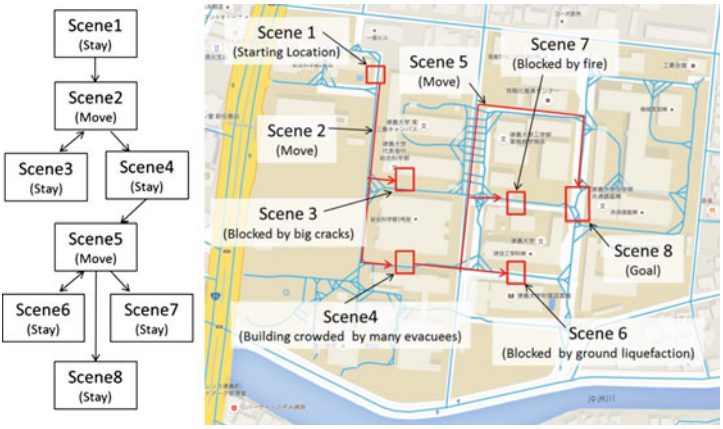


Fig. 6 Evacuation scenario (locations of SSs)

4.2 Results and Considerations

Almost all of the participants, who were familiar with the paths on their university campus, walked the same route due to the evacuation scenario. Table 2 shows the mean values of the participants' estimated and actual times for evacuation. There was no significant difference in the estimated time between the two groups. On the other hand, the actual time of Group B was significantly less than that of Group A. In addition, there was no significant difference between the estimated time and the actual time of Group B. These results indicate that the Googlevacuation simulates a speedier escape than the GBED and enables participants to escape as they estimated. These results are seemingly favorable but may give participants false expectations about escaping a real disaster. In other words, Googlevacuation does not sufficient homologize evacuation time with the GBED, i.e., insufficient experiential reality during evacuation (the sense of evacuation time). However, the GBED does not always simulate accurate evacuations. Real evacuation often takes more time than evacuation drills, and evacuation drills should inform participants that it is more difficult to escape during a real evacuation. Therefore, we believe that Googlevacuation should simulate slower evacuation by imposing restrictions on participant moving speed in GSV.

Table 3 shows the mean values of the questionnaire given to both groups. For all questions, the mean values of Group B were higher than those of Group A. There was significant difference in the mean values for Q3 about evacuation time.

Table 2 Mean estimated and actual evacuation time

Mean	Group A (GBED)	Group B (Googlevacuation)
Estimated time (min)	4.0	4.6
Actual time (min)	9.8	5.8

Table 3 Mean values of questionnaire for both groups

Question	Group A	Group B	t-test
Q1. Do you agree that this evacuation drill was realistic?	3.4	4.1	$p = 0.052$
Q2. Do you agree that this evacuation drill gave you a sense of tension?	3.1	3.5	$p = 0.375$
Q3. Do you agree that this evacuation drill stimulates evacuation time as you estimated?	1.3	2.8	$p = 0.016$*
Q4. Do you agree that this evacuation drill improved your awareness of disaster prevention?	4.2	4.4	$p = 0.511$
Q5. Do you agree that you were motivated to participate in this evacuation drill again?	4.0	4.4	$p = 0.207$
Q6. Do you agree that this evacuation drill is useful for disaster education?	4.5	4.9	$p = 0.127$

Table 4 Mean values of questionnaire for Group B

Question	Group B
Q7. Do you agree that this evacuation drill (Googlevacuation) made you feel that you actually escaped on the campus?	4.2
Q8. Do you agree that this evacuation drill can be replaced with evacuation drills in the real world?	4.2
Q9. Do you agree that this evacuation drill is practicable?	4.3

Although the mean value (2.8) for Q3 in Group B was not remarkably high, the difference corresponds to the results shown in Table 2. Note that the participants seemed to feel that they could have escaped more quickly. There was no significant difference ($p = 0.052$) in the mean values for Q1; however, the difference cannot be disregarded. We suppose that the GBED would be more realistic than Googlevacuation because the GBED is conducted in the real world. This result may have been caused by the tablet computer's small display. However, this result also indicates that the visual reality of GSV can satisfy the requirement of evacuation drills in a virtual world. The mean values for Q4, Q5, and Q6 in both groups were favorable. In addition to the GBED, Googlevacuation has strong potential as a new evacuation drill for disaster education.

Table 4 shows the mean values of the questionnaire given only to Group B. All the mean values were favorable. From these results, we consider that Googlevacuation will be accepted as a practicable evacuation drill if the experiential reality is improved.

5 Conclusions

This paper has discussed Googlevacuation, which realizes game-based evacuation drill (GBED) inside Google Street View (GSV). Googlevacuation allows people to perform evacuation drills easily, safely, and repeatedly in GSV while viewing digital materials (disaster situations) presented according to evacuation scenarios. The experimental results show that Googlevacuation has strong potential as a new evacuation drill; however, the experiential reality of evacuation (evacuation time) should be improved for practical disaster evacuation.

There have been evacuation drill systems in virtual worlds. For example, Dunwell et al. developed a simulation game about fire evacuation that allowed participants to evacuate from a virtual 3D building [10]. Regarding the combination of real world and virtual worlds, for example, Smith and Ericson developed a simulation game that realized virtual fire evacuation using an immersive display [11]. Wang et al. developed a simulation system for fire emergency evacuation using Building Information Modeling and a head-mounted display, and other technologies [12]. As shown in these examples, previous systems have primarily dealt with fire evacuation inside a building. On the other hand, Googlevacuation primarily deals with various disasters that occur outside.

There are many future challenges for Googlevacuation. For example, we must homologize evacuation time between the GBED and Googlevacuation. In addition, we must clarify the effectiveness of Googlevacuation through many experiments with a wider range of participants and regions.

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References

1. Munich, R.E.: NatCatSERVICE Loss Events Worldwide 1980–2014. http://www.preventionweb.net/files/44281_19802014paketworldusde4zu3.pdf
2. Tobita, J., Fukuwa, N., Mori, M.: Integrated disaster simulator using WebGIS and its application to community disaster mitigation activities. J. Nat. Disaster Sci. **30**(2), 71–82 (2009)
3. Kameda, H., Ghafory-Ashtiany, M., Dixit, A.M., Duncan, C., Fang, W., Ikeda, N., Nakamura, T., Negishi, H., Okada, N., Sharma, A., Shaw, R., Sasaki, M., Shiwaku, K., Shi, P., Scheer, S., Takara, K., Tatano, J.: Disaster reduction hyperbase (DRH)—allied knowledgebase platforms for disaster risk reduction. Int. Disaster Risk Conf. IDRC Davos **2010**, 378–383 (2010)
4. Kobayashi, K., Narita, A., Hirano, M., Tanaka, K., Katada, T., Kuwasawa, N.: DIGTable: a Tabletop simulation system for disaster education. In: Sixth International Conference on Pervasive Computing (Pervasive2008), pp. 57–60 (2008)
5. Mitsuhara, H., Sumikawa, T., Miyashita, J., Iwaka, K., Kozuki, Y.: Game-based evacuation drill using real world edutainment. Interact. Technol. Smart Educ. **10**(3), 194–210 (2013)

6. Miyashita, J., Mitsuhara, M., Miki, K., Sumikawa, T., Iwaka, K., Konishi, K., Kozuki, Y.: Web-based reflection support system for real world edutainment. IADIS Int. Conf. e-Soc. **2013**, 453–457 (2013)
7. Miki, K., Mitsuhara, H., Sumikawa, T., Miyashita, J., Iwaka, K., Konishi, M., Kozuki, Y.: Real world edutainment system and its application to evacuation drill. IADIS Int. Conf. e-Soc. **2013**, 59–66 (2013)
8. Zagal, J.P.: Ethically notable videogames: moral dilemmas and gameplay. In: Digital Interactive Games Research Association Conference (DiGRA 2009) (2009)
9. Mitsuhara, H., Inoue, T., Yamaguchi, K., Takechi, Y., Morimoto, M., Iwaka, K., Kozuki, Y., Shishibori, M.: Web-Based system for designing game-based evacuation drills. Proc. Comput. Sci. **72**, 277–284 (2015)
10. Dunwell, I., Petridis, P., Arnab, S., Protopsaltis, A., Hendrix, M., Freitas, S.: Blended game-based learning environments: extending a serious game into a learning content management system. In: Third International Conference on Intelligent Networking and Collaborative Systems (INCoS), pp. 830–835 (2011)
11. Smith, S., Ericson, E.: Using immersive game-based virtual reality to teach fire-safety skills to children. Virtual Reality **13**(2), 87–99 (2009)
12. Wang, B., Li, H., Rezgui, Y., Bradley, A., Ong, H.N.: BIM based virtual environment for fire emergency evacuation. The Scientific World J. (2014) 10.1155/2014/589016

Ergonomic Considerations of the Gaming Classroom

Katelyn Procci

Abstract As the game-based training industry grows, games are increasingly being used within traditional classroom environments. In at least one case, an entire classroom-based course will feature daily training game play over the course of several weeks. To date, there has not been an ergonomic evaluation of the so-called gaming classroom. This work summarizes the existing literature with respect to the ergonomics of two similar contexts—office work and prolonged gameplay. This includes topics such as the ergonomics of various input devices for prolonged use (e.g., mouse, keyboard, game controllers), work station design, and overall course time management to prevent muscle strain and fatigue. Recommendations with respect to the above are provided.

Keywords Game-based training · Ergonomics

1 Introduction

The video game-based training industry has exploded in recent years, and rightfully so. These so-called serious games are compelling training tools because, when thoughtfully-designed and well-executed, they create virtual training environments that feature appropriate fidelity, deliver various levels and types of feedback, and instill motivation in their players. Serious games may be easy to distribute and provide consistent training experiences across users. They can also be used to train individuals on tasks that are otherwise too dangerous or cost-prohibitive for real-world exercises. Much of the serious games literature focuses on best-practices for design with respect to instructional game features, harnessing engaging gameplay, and training effectiveness [1–3]. For example, Sitzmann [3] found that more effective serious games are those embedded within a larger training program. An example of this is a classroom that augments traditional lecture-based instruction

K. Procci (✉)
Cubic Global Defense, Orlando, FL, USA
e-mail: katelyn.procci@cubic.com

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with opportunities for practice and application via serious game. To date, there has been little—if any—analysis of the unique ergonomic implications of the game-based training classroom. This is an especially pertinent aspect to consider if the serious game is to be a prolonged experience as opposed to a one-off training intervention that may only last an hour or two. Importantly, negative health effects related to lengthy stretches of video game play have been documented since the 1990s [4, 5].

This work summarizes the existing literature with respect to the ergonomics of prolonged video game play. This includes topics such as the ergonomics of various input devices for prolonged use (e.g., mouse, keyboard, game controllers), work station design, and overall course time management to prevent muscle strain and fatigue.

2 Defining the Gaming Classroom

The first task is to define what the game-based training classroom may look like, as well as to hypothesize how that experience aligns with comparable contexts. Game-based training can span a variety of platforms, from mobile devices to stationary computer workstations. While there are several emergent game-based training technologies, such as immersive virtual reality trainers built on devices such as the Oculus Rift, training that is expected to be in-depth and prolonged will likely take place on a computer or a dedicated gaming console. These are the most common ways that games are typically played [6]. Computer games in particular are likely the most viable method for training game development, as there are several free game engine platforms that developers can use such as Unreal 4 or Unity. Computer games for training are also flexible with respect to their hardware configuration, as computer cases can come in a variety of sizes and all input devices are supported, from traditional mouse and keyboard inputs to specialized peripherals. With this in mind, the most similar contexts which can be compared to the hypothetical gaming classroom is that of typical office work and of professional gaming.

Regarding typical office work, The average workday length for American persons employed in office or administrative positions was 7.64 h in 2014 [7]. This task involves an individual sitting at a work station in front of a visual display using some sort of input device, most commonly a keyboard and mouse [8]. According to Wahlstrom [8], this prolonged, low-load static work results in musculoskeletal disorders affecting the neck, shoulders, wrists, and hands. Computer vision syndrome is also commonly reported, which includes blurred vision, dry and burning eyes, eye soreness, and headaches resulting from prolonged use of visual display devices as well as lighting issues and improper workstation design [9]. Other factors contribute to the development of these disorders, such as stress due to deadlines at work [8]. Those in the gaming classroom are likely to experience a similar set-up, where students sit at a computer, playing through the training using a mouse and keyboard, for a set number of hours every day.

If the physical environment mirrors that of office work, typical behaviors of game-players may shed light onto the temporal aspects of the gaming classroom and how that might affect the incidence of musculoskeletal disorders. The 2015 report from the Entertainment Software Association found that 42 % of Americans surveyed play games 3 h or more every week [6]. While they did not report how many hours were typically played on single-player games, the average amount of time spent playing with others online was 6.5 h per week. The hours spent in the office daily nearly equates to that which an individual would spend in an entire week playing games for fun. Even at this level, playing games has been reported to result in injury, such as hand and arm pain and muscle stiffness [10]. Interestingly, in a survey of 636 middle and high school students, daily computer usage but not playing games was associated with increased odds of reporting back or neck [10].

There are more extreme examples of game players, which likely better represents what a gaming classroom may look like. Competitive gaming, known as eSports, has become a booming industry is recent years, where competitions fill stadiums and are simultaneously viewed online by the millions [11]. As an example, professional *League of Legends* players practice playing the computer-based game for 50 h a week, at minimum, where some dedicated individuals play between 12 and 14 h a day [12]. Some eSports leagues feature intense competition, and in conjunction with the mental and physical demands of prolonged training, most professional gamers retire before they turn 30 [13]. Such repetitive, prolonged gameplay does take a toll. Maiberg [14] interviewed Dr. Levi Harrison, an orthopedic surgeon who specializes in hand and upper extremity injuries. His most common patients are mixed martial arts fighters and eSports competitors. Maiberg [14] reported one case of an eSports competitor who had to retire at age 22 due to a gaming-induced wrist injury.

While the gaming classroom will likely not emulate the extreme nature of eSports professionals' training regimens, it likely aligns better than to that of the typical gamer. A gaming classroom may, then, mirror the workweek, with students playing the training game five days a week, for about seven hours a day. An example of one such classroom is that of the US Navy's Surface Warfare Officers School Command (SWOS), where game-based training will be prominently featured in a 27-week long training course for sailors [15]. Therefore, the interventions used to prevent injuries on the job and for eSports professionals could also be applied to such a gaming classroom, to include aspects of workspace design and course time management to minimize strain and injury.

3 Workspace Design

Workspace design includes the type of furniture and equipment as well as their relative positioning to minimize muscular strain and optimize performance capabilities.

Workstation Layout. The ANSI/HFES 100-2007 standards outline the various ways that workplace design may reduce the incidence of musculoskeletal disorders

[16]. They recommend that chairs should be adjustable—to include a reclining backrest at least 15°, adjustable seat pan, adjustable height—and the chairs should also provide both lumbar support and thigh support. Detachable, adjustable arm rests are recommended so that they can be manipulated or removed based on user preference. The standards also defined four potential postures for sitting at a workstation: reclined sitting, upright sitting, declined sitting, and standing. The notion is that any workstation design should accommodate at least two of those postures based on the preference of the individual, although not all postures, even those preferred by the user, are conducive to productivity. Regardless of the posture, the standards recommend that the workspace accommodate the following:

- Elbows: 70–35°
- Shoulder abduction: >20°
- Shoulder flexion: >25°
- Wrist flexion: >30°
- Wrist extension: >30°
- Torso-to-thigh: $\geq$90°

Support devices should also be used where possible. These devices, such as arm and wrist rests, "reduce[s] activity and to facilitate more neutral wrist angles" [16 p. 20]. Arm rests should sit 17–27 cm above the seat pan. Wrist supports should be used, but shouldn't be too soft and should be able to maintain a constant temperature. For prolonged use, supports should be provided for the forearms and wrists that are adjustable with respect to both height and tilt. Wrist supports that are less than 1.5″ deep should be avoided. Finally, palm and wrist supports should be a wide, flat surface of at least 1.5″ [16].

Input Devices. The ANSI/HFES 100-2007 standards assert that all input devices should be located between resting forearm between the shoulders. The primary input devices should be within reach of resting forearms without extension of the arm. The workspace itself should be at least 70 cm wide, to accommodate the range between a typical male user's forearms and accounting for changes in posture [16]. A variety of input devices can be used during game-based training, to include keyboards, mice, joysticks, touch screens, and game controllers.

Keyboards should have an adjustable slope between 0 and 15° as well as feature a keyboard rest for the wrists that transitions smoothly into the keyboard itself. This minimizes muscle strain while typing and promotes user comfort [16]. Pressing keys with more force results in strain, so the need to press hard should be minimized with the chosen keyboard. The ANSI/HFES 100-2007 standards suggest that the force to activate keys to be 0.25 and 1.5 N, although users preferred amount of force tends to be between 0.5 and 0.6 N [16]. Mechanical keyboards are popular with gamers who play on computers, in part because their design allows keys to be pressed more quickly. Mechanical keyboards use different types of switches that require different amounts of pressure to activate the keys. Depending on the switch used in the mechanical keyboard, they may require less force to actuate the keys than other types of keyboards [17]. When evaluating keyboard options, examine the

force needed to activate keys (see Ref. [18] for an overview of the difference between mechanical keyboard switches). This does not necessarily mean that a mechanical keyboard should be selected as any keyboard is adequate as long as the force required to active keys is within the optimal range and it is comfortable for the user.

As for mice, the ANSI/HFES 100-2007 standards recommend the use of rectangular mice, between 40 to 70 mm wide, 70 to 12 mm long, and 25 to 40 mm high for adults. The standards warn against using mice that are too form-fitting as the skin is unable to breathe and will perspire [16]. Additionally, mice that are too large or too small will strain and contort the hand. Mohamed et al. [19] evaluated a typical mouse, a small mouse, and a 'gaming' mouse and found that the gaming-style mouse was optimal for prolonged use because. While it did not feature the least amount of wrist extension of the mice examined, it was rated to be the most comfortable. A gaming mouse that fits the standards' sizes above and is not too large, small, or form-fitting for the target audiences' hands is adequate.

Joysticks or styluses may also be used as input devices. The ANSI/HFES 100-2007 standards suggest that joysticks should be less than 50 mm in diameter, between 110 and 180 mm long, and should require at least 4.5 N to be activated. Importantly, the resting angle of the joystick should not be kept at more than 45° or else the wrist will be strained. If a stylus is to be used, its diameter should be between 7 and 20 mm, with a length between 120 and 180 mm, recommendations for which were based on both anthropometrics and overall usability of such devices [16]. Touch pads and screens are also another input option. Touch input areas should be at least 9.5 mm by 9.5 mm, with a dead-space surrounding the touch area of at least 3.2 mm [16].

Many games are played with specially-designed controllers. These controllers can cause blisters [10], although the occurrence of such is highly dependent on the design of the input device itself. As a case study, entertainment game giant Nintendo is no stranger to injuries caused by their controllers, all of which have varied radically over time. Jalink et al. [5] summarized the extant literature of Nintendo-related injuries and found 38 papers, with the papers being divided into pre- and post-Wii categories. The Wii is Nintendo's most revolutionary controller where the company moved away from traditional handheld controller inputs to motion-based wands with integrated joysticks and buttons. Reported pre-Wii injuries included neck pain, 'Nintendo elbow' which is acute tendonitis, 'Nintendo thumb' which are swollen digits, and even palm ulcers from N64 joysticks while playing *Mario Party*. With the active nature of the Wii, the types of injuries reported mirrored that of sports. Common injuries included bruises, lacerations, and acute tendinitis. Other more extreme reports include dislocated knees, broken bones, and one case of a 7 year old boy being permanently blinded after being hit in the eye while playing *Wii Sports*. The authors are careful to note that injuries such as these have a low prevalence, but do summarize the experience of Nintendo controllers as such: "Excessive game play with traditional controllers is associated with tendinitis of the thumb; the Nintendo 64 joystick can lead to palmar ulceration;

and the motion sensitive Wii remote can cause musculoskeletal problems and various traumas" [5, p. 3].

Since controllers are all unique, it may be more useful to evaluate a select few. For example, when designing a new controller, authors Micire et al. [20] followed the following six ergonomic principles: that the controller should "avoid outer positions, avoid repetition, relax muscles, relaxed neutral position is in the middle between outer positions, avoid staying in static position, and avoid internal and external force on joints and stopping body fluids" (p. 90). These same principles can be applied to the evaluation of potential controllers.

Visual Displays. The placement of the visual display units is essential. If these are too small, too far away, or are at strange angles, ocular strain may occur. For example, in a study of children in Japan, "the blurry target of small handheld games produced a greater accommodative load than larger computer screens or cartoon drawings (Sakata et al. 1997)" [10, p. 18]. This strain could exacerbate computer vision syndrome.

Shantakumari et al. [9] found that viewing distances smaller than 50 cm resulted in individuals being significantly more likely to develop headaches from eye strain while using visual displays. The same recommendation is found in the ANSI/HFES 100-2007 standards. Additionally, the researchers also found not using filters on screens increased the occurrence of dry eyes by 89 %.

The ANSI/HFES 100-2007 standards also make several recommendations based on the literature. For example, the visual display be placed between 50 and 100 cm away from the eyes and not angled more than 35 % from the main line of sight. Additionally, "horizontal eye level to screen center angles of 15–20° at distances of 75–83 cm … appear to be a reasonable comprise" [16, p. 23], with "top of the viewing area 5° below horizontal eye level with center of the screen 25° below horizontal to promote best visual experience balanced with muscular strain" [16, p. 24]. Lastly, everything that is a part of the workstation, including visual displays and input devices, should be between 0 and 60° below eye height [16].

4 Course Time Management

Whether it's completing work on a computer or playing a game for entertainment, sustaining such activities over a prolonged period of time may be difficult. While a well-designed workspace may mitigate strain, taking breaks and stretching may also be beneficial [21].

Citing Johnson (1998), Wahlstrom [8] reported that using a mouse for between 3 and 4 h resulted in muscle fatigue. Similarly, those who use computers more than 5 h a day are more at risk for developing computer vision syndrome [22]. Logaraj et al. [22] found in their study that students who took a brief break from using a computer every hour had fewer computer vision syndrome symptoms than who took a break after 2 h. Additionally, standing up and engaging in other light physical activities during these breaks has "been shown to reduce musculoskeletal

(e.g. low back) discomfort and fatigue in office workers" [23, p. 4]. Specific hand and arm stretches designed for professional gamers may also be beneficial [24].

Therefore, students in the gaming classroom should take short breaks roughly every hour of gameplay. The game itself can create natural breakpoints. For example, match-based eSports games all feature varying typical math lengths, however the average type is around 71 min per session [25]. Some games that do not feature such inherent breaks and instead prompt players to take breaks at regular, hourly intervals [26, 27].

Additionally, in a survey-based study of 387 children exploring typical gameplay behaviors, 61 % of the sample tended to play games for sessions that lasted no longer than 2 h [28]. This suggests that, in general, game-based training sessions should be designed to be only an hour or two as that mirrors the typical preference for play. As an aside, forcing longer play times may be detrimental and game-based training could be seen more as a chore than an enjoyable and educational activity. This would minimize one of the major benefits of embedding training within a gaming context. Additionally, the typical attention span for students in a traditional classroom setting tends to wane after 15–20 min resulting in less effective training [29]. Therefore, if the gaming classroom could be limited to only a couple of hours of game-based training a day, that is optimal. If not, incorporate brief breaks for standing and stretching exercises hourly.

5 Recommendations for the Gaming Classroom

Based on this review, ergonomic recommendations for the design of the gaming classroom can be summarized as such:

- Design the layout of the workstation with supportive, adjustable furniture with measurement and movement allowances within the ANSI/HFES 100-2007 standards.
- Utilize support devices such as arm and wrist rests for prolonged periods of gameplay.
- Select keyboards that are adjustable and evaluate the amount of force needed to press keys, aiming for between 0.5 and 0.6 N.
- Gaming-style mice are acceptable long as they are not too big, too small, or too form-fitting for the target audiences' hands, where the optimal size for an adult is between 40–70 mm wide, 70–12 mm long, and 25–40 mm high for adults.
- Controllers will need to be evaluated on a case-by-case basis as all controllers are different. In general, the controller should promote a neutral hand position, should not feature any sharp edges or pressure points, and should minimize repetitive activities for operation.
- Visual displays should be placed no closer than 50 cm from the users' eyes.
- Use screen filters to help prevent experiencing dry eyes.
- Do not angle visual displays more than 35 %.

- The top of the visual display should be 5° below eye level.
- The center of the visual display should be 25° below eye level.
- All input devices and visual displays should be between 0 and 60° below eye level.
- Plan for breaks. Design natural breakpoints in gameplay progression that allows for short breaks roughly every hour, or potentially reminder messages. Or else, direct instructors to facilitate break periods. During these breaks, encourage students to stand or complete hand and arm stretches.

Please note that this review focused on adult students. Specific recommendations for children may differ as there is often a mismatch, at least in computer-based classrooms, for children with the equipment [10]. Future work in this area should focus on the needs of child populations. Additionally, there were several other relevant topics not discussed in this review pertaining to the ergonomics of emerging technologies, such as head-mounted displays (HMDs), mobile gaming, gesture-based input systems, and simulator sickness.

References

1. Procci, K., Bowers, C.: Instructional and gaming elements: what are they and where do they intersect? In: Hussain, T.S., Coleman, S.L. (eds.) Design and Development of Training Games: Practical Guidelines from a Multidisciplinary Perspective, pp. 55–92. Cambridge University Press, New York (2015)
2. Connolly, T.M., Boyle, E.A., MacArthur, E., Hainey, T., Boyle, J.M.: A systematic literature review of empirical evidence on computer games and serious games. Comput. Educ. **59**, 661–686 (2012)
3. Sitzmann, T.: A meta-analytic examination of the instructional effectiveness of computer-based simulation games. Pers. Psychol. **64**(2), 489–528 (2011)
4. Zapata, A.L., Moraes, A.J.P., Leone, C., Dora-Filho, U., Silva, C.A.A.: Pain and musculoskeletal pain syndromes related to computer and video game use in adolescents. Eur. J. Pediatr. **156**, 408–414 (2006)
5. Jalink, M.B., Heineman, E., Pierie, J.-P., ten Hoedemaker, H.O.C.: Nintendo related injuries and other problems: review. Brit. Med. J. **349**, g7267 (2014)
6. ESA: Essential facts about the computer and video game industry. http://www.theesa.com/wp-content/uploads/2015/04/ESA-Essential-Facts-2015.pdf (2015)
7. Bureau of Labor Statistics. Economic news release: Table 5. Employed persons working in main job and time spent working on days by class of worker, occupation, earnings, and day of week, 2014 annual averages. http://www.bls.gov/news.release/atus.t05.htm (2015)
8. Wahlstrom, J.: Ergonomics, musculoskeletal disorders and computer work. Occup. Med. **55**, 168–176 (2005)
9. Shantakumari, N., Eldeeb, R., Sreedharan, J., Gopal, K.: Computer use and vision-related problems among university students in Ajman, United Arab Empire. Ann. Med. Health Sci. Res. **4**, 258–263 (2014)
10. Gillespie, R.M.: The musculoskeletal impact of computer and electronic game use on children and adolescents. Doctoral dissertation (2006)
11. Hollist, K.E.: Time to be grown-ups about video gaming: the rising eSports industry and the need for regulation. Ariz. Law Rev. **57**, 8230–847 (2015)

12. Jacobs, H.: Here's the insane training schedule of a 20-something professional gamer. http://www.businessinsider.com/pro-gamers-explain-the-insane-training-regimen-they-use-to-stay-on-top-2015-5 (2015)
13. DiChristopher, T.: Pro gamers story: get big, burn out, retire young. CNBC. http://www.cnbc.com/2014/02/01/pro-gamers-story-get-big-burn-out-retire-young.html (2014)
14. Maiberg, E.: Achilles' writs: meet the doctor who is saving eSport careers. http://motherboard.vice.com/read/achilles-wrists-meet-the-doctor-who-is-saving-esports-careers (2015)
15. Bilbro, J.: Surface warfare officers school: ready on arrival. http://www.public.navy.mil/surfor/swmag/Pages/SWOS-Ready-on-Arrival.aspx (2014)
16. ANSI/HFESS. Human factors engineering of computer workstations. Santa Monica, Human Factors and Ergonomics Society (2007)
17. Manyak. [Official] Mechanical keyboard guide. http://www.overclock.net/t/491752/official-mechanical-keyboard-guide (2009)
18. WASD Keyboards, Mechanical keyboard guide. http://www.wasdkeyboars.com/mechnical-keyboard-guide
19. Mohamed, M.S.S., Mei, C.Z., Hui, Y.H.: Ergonomics evaluation on non keyboard input devices. Univeral J. Manag. Soc. Sci. **3**, 65–69 (2013)
20. Micire, M., McCann, E., Desai, M., Tsui, K.M., Norton, A., Yanco, H.A.: Hand and finger registration for multi-touch joysticks on software-based operator control units. IEEE (2011)
21. Henning, R.A., Jacques, P., Kissel, G.V., Sullivan, A.B., Alteras-Webb, S.M.: Frequent short rest breaks from computer work: effects on productivity and well-being at two field sites. Ergonomics **40**, 78–91 (1997)
22. Logaraj, M., Madhupriya, V., Hegde, S.K.: Computer vision syndrome and associated factors among medical and engineering students in Chennai. Ann. Med. Health Sci. Res. **4**, 179–185 (2014)
23. Buckley, J.P., Hedge, A., Yates, T., Copeland R., Loosemore, M., Hamer. M., Bradley, G., Dunstan, D.W.: The sedentary office: a growing case for change towards better health and productivity. Brit. J. Sport Med. **49**, 1357–1362 (2015)
24. Harrison, L.: eSports coaching. http://drleviharrison.com/esports-coaching
25. Newzoo. September PC game rankings: the meteoric rise of archeage & session times vs. genres. https://newzoo.com/insights/articles/september-pc-game-rankings-meteoric-rise-archeage-session-times-vs-genres
26. Jalink, M.B., Heineman, E., Pierie, J.-P.E.N., tan Hoedemaker, H.O.C.: Nintendo related injuries and other problems: Review. Brit. Med. J. **349**, g7267 (2014)
27. Irwin, J.: Should more games tell us to stop playing and do something else? https://killscreen.com/articles/should-more-games-tell-us-stop-playing-and-do-something-else/
28. Griffiths, M.D., Hunt, N.: Computer game playing in adolescence: prevalence and demographic indicators. J. Community Appl. Soc. **5**, 189–193 (2006)
29. Burns, R.A.: Information impact and factors affecting recall. Paper presented at the 7th Annual National Conference on Teaching Excellence and Conference of Administrators in Austin, TX (1985)

Effective Game-Based Training at the Point of Need

Erika Darling, James Benslay, Rick Osborne, Joe Clapis and Rich Crutchfield

Abstract The military requires delivery of training to the warfighter at the point of need, which means whenever and wherever the training is needed. We set out to determine if a soldier could train using a graphically intensive game hosted in a "cloud." We conducted a usability study in a lab with twelve participants trying to complete a mission using a military simulation training game. The participants played the game in ten different configurations that varied the number of VMs per server, CPU cores and CPU topologies of the VMs, screen resolution settings, and WAN emulator bandwidth and latency settings. The usability study found that the simulation training game performed acceptably in a virtualized environment. It also determined that with the specific hardware and network characteristics used in the study, participants rated 6–8 VMs set to low-resolution best.

Keywords Usability · Training · Cloud · Responsiveness · Latency

1 Introduction

The military requires delivery of training to the warfighter at the point of need, which means whenever and wherever the training is needed. We set out to determine if a soldier could effectively train using a graphically intensive game hosted in

E. Darling (✉) · J. Benslay · R. Osborne · J. Clapis · R. Crutchfield
The MITRE Corporation, Tampa, FL, USA
e-mail: edarling@mitre.org

J. Benslay
e-mail: jbenslay@mitre.org

R. Osborne
e-mail: rosborne@mitre.org

J. Clapis
e-mail: jclapis@mitre.org

R. Crutchfield
e-mail: crutchfield@mitre.org

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a "cloud." By cloud, we mean that there are a variety of computing services made available to users, but the specific location of the machines providing the services, and the specific software technologies making the services available is not known to the requesting users.

For the purpose of our study, the cloud was simulated by a standard, commercial class server running a hypervisor operating system coupled with a Wide Area Network (WAN) emulator that allowed us to explicitly apply network bandwidth and latency settings to simulate a variety of realistic network conditions.

It is generally true to say that the lower the amount of network transmission latency, the better the game responsiveness should be. This is analogous to saying that when a person is playing a game on a standalone machine with no network involved, and when the person provides inputs to the game with a mouse or controller, the person will expect to see the results on the screen immediately with no discernable delay. Similarly, the higher the amount of network transmission latency, the worse the game responsiveness should be. Unfortunately, there is no absolute scale that specifies at what degree of latency the responsiveness of a game will become unacceptable.

Some games are more sensitive than others with regards to how much a certain amount of network latency will affect gameplay and thus acceptability. Previous research has categorized games in three ways—first-person avatar, third-person avatar, and omnipresent—and determined that first-person avatar games are the most sensitive to latency [1]. In our study, we used a first-person avatar training simulation game used by the military. A literature survey determined that a delay of 60 ms is the upper bound for how much latency is acceptable for first-person avatar games [2]. It has also been noted that the relationship between latency, frame rate, and the quality of the player experience has been studied but that resolution had not been thoroughly explored [3]. Our study took into account screen resolution in addition to latency, frame rate, and quality of the user experience.

2 Method

A key objective of this study was to determine the maximum number of VMs that could be run concurrently from the VM server while still maintaining an acceptable level of performance such that training would not be impacted. We accomplished this through two phases: an exploratory phase followed by a usability testing phase. The purpose of the exploratory phase was to test many configurations and down-select to the configurations that would be assessed further in the usability testing phase. The purpose of the usability testing phase was to gather subjective feedback from participants who had not been part of the exploratory phase on how usable the performance of the training game was.

2.1 Exploratory Phase

For the exploratory phase, we assessed the acceptability of the performance both objectively and subjectively. We gauged the objective measurement by graphical frames per second generated within the VMs and at the thin-clients. Subjectively, we assessed how easy or difficult it was to play the training game. During the exploratory phase, we ran 49 tests over three days that examined a number of different combinations of VMs, CPU cores and CPU topologies, RAM allocation, vGPU allocation, and training game configurations. We down-selected from the 49 configurations to ten that we wanted our test participants to evaluate during the usability testing phase (see Table 1). In Table 1, the columns represent the name we assigned to the configuration, the number of VMs, the number of physical CPUs, the screen resolution, the latency we introduced using the WAN emulator, the bandwidth cap, and on which day of testing we ran that configuration. The order in Table 1 was not the actual test order. Instead, we randomized the test order through two separate people to try to eliminate any bias that would come from the participants being able to anticipate the next condition.

2.2 Usability Testing Phase

For the usability testing phase, we recruited twelve MITRE summer interns to participate. The participants covered the range of experience levels from being new to first-person shooter games to being proficient in them. Prior to beginning the usability testing, we gave a five-minute overview of the study to explain that we were interested in the participants' feedback on the responsiveness of the game and not their feedback on how easy it was to figure out how to use the controls of the game. We also emphasized that we were not testing the participants' abilities to

Table 1 Ten configurations that we selected during the exploratory phase to be evaluated by test participants in the usability testing phase

Name	# of VMs	Physical CPUs	Resolution	Latency	Bandwidth cap	Day
A	6	1	1920 × 1080	N/A	N/A	2
B	6	1	1440 × 900	N/A	N/A	2
C	6	2	1920 × 1080	N/A	N/A	1
D	8	2	1920 × 1080	N/A	N/A	1
E	6	2	1440 × 900	N/A	N/A	1
F	8	2	1440 × 900	N/A	N/A	1
G	6	2	1920 × 1080	5–25 ms	70 Mb/s	1
H	6	2	1920 × 1080	25–50 ms	80 Mb/s	1
J	6	2	1440 × 900	25–50 ms	80 Mb/s	1
K	6	2	1440 × 900	50–75 ms	70 Mb/s	1

play first-person shooter games. At that point, we divided the twelve participants into two groups of six to train as a team based on the results of the exploratory phase that around six to eight virtual machines would be the maximum acceptable performance. The first group of six played for 3 h in the morning and the second group of six played for three hours in the afternoon. When test runs required 8 VMs, we simulated activity on the two extra machines while the six test participants played simultaneously.

For each group of six participants, we first briefed them on their mission to capture a high-value target in the training game while reiterating that it did not matter to the study whether or not they successfully completed the mission. The participants sat around a table and had identical laptops in front of them and could communicate either face-to-face or over headsets depending on their preference. Each of the six workstations were mirrored onto a data wall on one side of the room (see Fig. 1 for the room layout).

After the initial briefing, each participant spent about ten minutes being trained individually on the training game controls on a standard military training laptop. It is important to note that this was a standard configuration laptop because participants would be asked to compare the performance of the test runs to the performance of the laptop used during training. At the end of training, the participants completed a short survey indicating to what extent they considered themselves to be gamers, their experience with first-person shooter games, and how responsive the game was.

Once the training was completed, each participant evaluated ten different test runs total. Because of the time required to set up two of the configurations (A & B), they evaluated eight the first day and returned the following morning to complete the two remaining configurations. They were unaware of which configuration they



Fig. 1 Room layout for the usability study

were evaluating at a given time. Participants played each one for 10 min to give them enough time to formulate an opinion on the responsiveness of the game. After 10 min, the participants were asked to leave the room to fill out a short questionnaire while the next configuration was set up. The second questionnaire rated their level of agreement with five statements having to do with responsiveness, consistency of the game performance, and screen resolution. There was also space on the questionnaire to provide open-ended comments. We emphasized again that we were only interested in their opinions of the responsiveness of the game and not how intuitive it was to navigate through the game using the game controls.

3 Results

3.1 Exploratory Phase

Based on the objective frame rate data and subjective opinions gathered during the exploratory phase, we felt that configuration C, which was six VMs with high-resolution (1920 × 1080), and configuration F, which was eight VMs with low-resolution (1440 × 900), would be the two candidates for the upper performance bound of acceptable for training.

3.2 Usability Testing Phase

For the surveys, participants rated their answers on a five-point Likert scale ranging from 1 being Strongly Disagree to 5 being Strongly Agree [4]. Table 2 contains the average rating given to each of the three questions in the first questionnaire that they filled out after completing the training.

The average rating for the question about being a gamer was 3.1, which represents a neutral rating. Similarly, the average rating for the question about experience playing first-person shooter games was 3.4. This underscores the point that participants spanned the range of experience levels with being gamers and playing first-person shooter games from novices to experts. The average rating for the game being responsive was 4.2, which indicates agreement with that statement.

Table 2 This table lists the average ratings to each of the questions in the first questionnaire

Survey question	Average rating
1. I consider myself to be a gamer	3.1 (Neutral)
2. I have played First-Person Shooter games	3.4 (Neutral)
3. The game was responsive, meaning I did not notice a delay for the game to respond to my inputs	4.2 (Agree)

The first set of charts, Figs. 2, 3 and 4, show the participants' responsiveness ratings across the ten test runs. Figures 2 and 3 contain the responsiveness ratings for the test runs that varied the number of VMs, the CPU topology, and the resolution but did not adjust network latency. They are separated into two charts because test runs C-F happened on the first day and test runs A-B occurred the following morning.

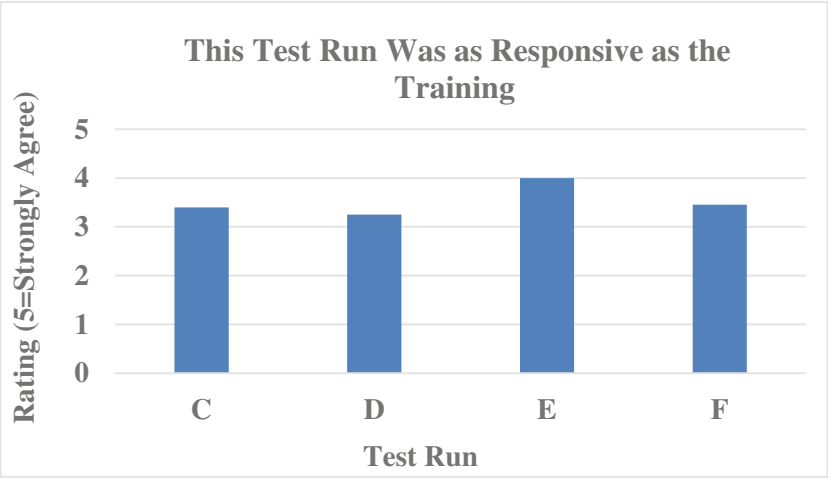


Fig. 2 This figure contains the average responsiveness ratings for test runs C-F

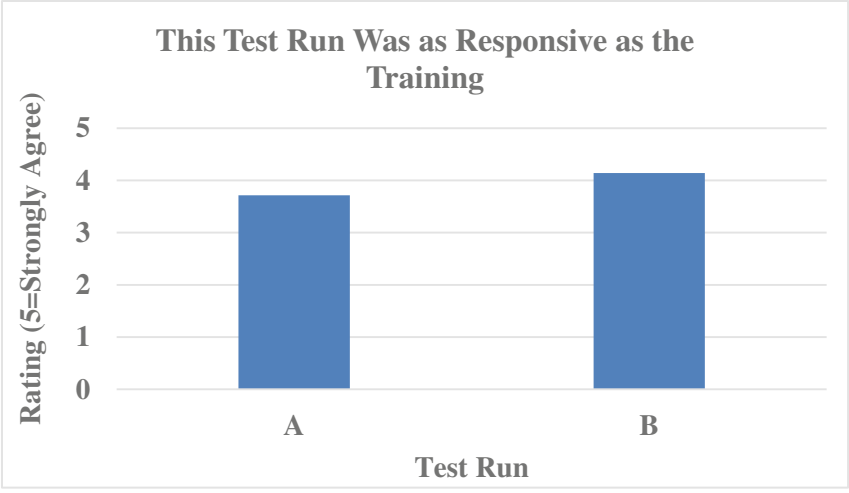


Fig. 3 This figure contains the average responsiveness ratings for test runs A and B

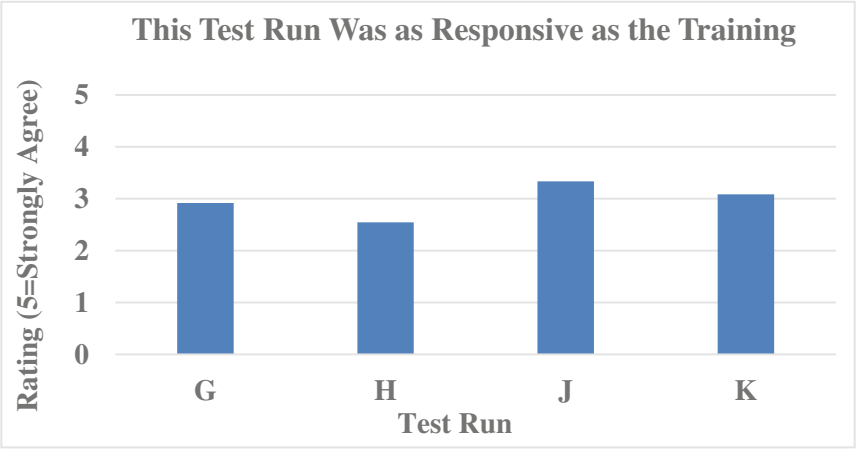


Fig. 4 This figure contains the average responsiveness ratings for test runs G-K

As shown in Fig. 2, participants rated test run E as the most responsive, agreeing that it was as responsive as the training configuration. Test run E had six VMs with the screens set at low-resolution. The average ratings for test runs C & F, which we believed were the candidates for the upper performance bound, were close behind that of test run E.

As noted previously, the participants were asked to return the following morning to complete two additional test runs. These test runs required significant setup time and weren't feasible to conduct on the first day. Their responsiveness ratings are in Fig. 3. It is the team's belief that their scores are inflated because of the time that had elapsed between the training and the test runs on the second day. The participants likely remembered the performance to be worse than what they had rated it the day before. The team feels that if all test runs had been completed on the first day that test run E would have been rated the highest.

Figure 4 shows the responsiveness ratings when network latency was introduced and the bandwidth was capped. They are lower than the responsiveness ratings in test runs A-F when there was no latency introduced or bandwidth capped, which is what one would expect. The participants rated test run J as the most responsive, which consisted of 6 VMs at low-resolution with medium-latency. The WAN latency was 25–50 ms and WAN bandwidth was capped at 80 Mbps. It's interesting to note that configuration K had the highest latency applied (50–75 ms) but H was rated as less responsive because it was higher-resolution than K.

As shown in the previous results, participants rated test runs higher when screen resolution was lower. We asked participants in the survey if screen resolution impacted their ability to play the game. As shown in Fig. 5, all test runs scored

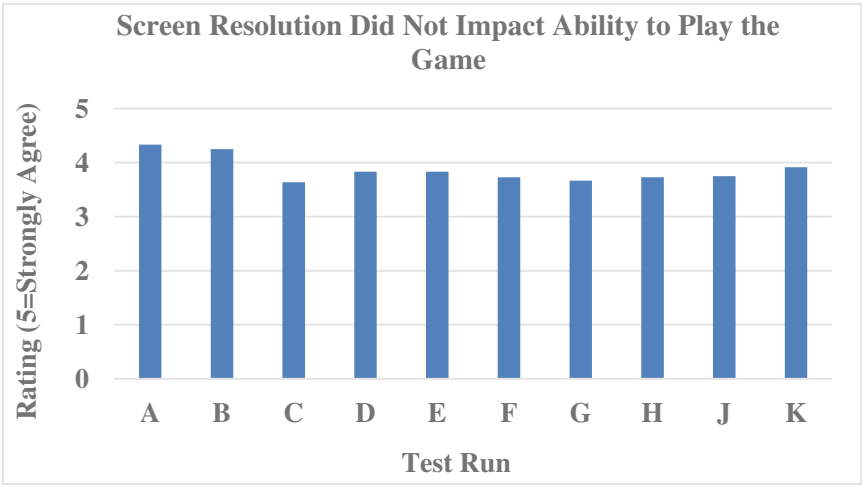


Fig. 5 This figure contains the average ratings for screen resolution not impacting ability to play the game for all test runs

roughly the same meaning that screen resolution did not seem to impact their ability to play. Test runs A and B were rated higher but the team believes this is because participants completed these on a separate day and bias was introduced.

4 Discussion

To eliminate any bias that we may have introduced, we recommend future studies be conducted in a single day to ensure that ratings are as consistent as possible across configurations.

Despite this, we feel the usability testing phase confirmed that participants felt the simulation training game performed acceptably in a virtualized environment. It also validated that with the hardware and network characteristics used in the study approximately 6–8 VMs set to low-resolution were rated highest by the participants. We learned through the usability study that screen resolution impacted participants' ratings of responsiveness more than we had thought it would. It is important to note that the mission the participants were asked to complete in the study did not rely on fine-grained visualizations that would require high-resolution to notice small details. This trade-off between resolution and responsiveness should be explored further in future studies.

We also recommend future studies assess to what extent latency impacts the effectiveness of the training to determine if a team that experienced greater latency during training is less skilled than one that has not experienced latency during training.

References

1. Claypool, M., Finkel, D.: The effects of latency on player performance in cloud-based games. In: Proceedings of 13th Annual IEEE/ACM NetGames, pp. 1–6 (2014)
2. Raaen, K., Gronli,T-M.: Latency thresholds for usability in games: a survey. In: Proceedings of NIK-2014 (2014)
3. Huang, C.-Y., Hsu, C.-H., Chen, D.-Y., Chen, K.-T.: Quantifying user satisfaction in mobile cloud games. In: Proceedings of Workshop on Mobile Video Delivery, pp. 1–6. Singapore (2014)
4. Likert, R.: A technique for the measurement of attitudes. Arch. Psychol. **140**, 1–55 (1932)

"How Good Is Good Enough?" Exploring Validation for Serious Gaming in Air Traffic Control

Hayley J. Davison Reynolds, Rich DeLaura and Brian Soulliard

Abstract This paper describes the iterative validation process used in the development of a serious game for training air traffic managers in the National Airspace System. For complex system simulations, it can be difficult to determine when is "enough" validation. Several development cycles of NASPlay are described and the validation effort examples within each cycle are presented. A process model for piece-wise functional validation is proposed, and how to draw the threshold for "enough" validation from a practical standpoint is addressed.

Keywords Training · Human-systems integration · Systems engineering · Gaming · Validation

1 Introduction

The NASPlay (National Airspace System- Play) air traffic management training serious game was developed in response to a high turnover in air traffic managers in the recent few years. The game addresses a need for training materials that help traffic managers understand the complex behaviors of the NAS under a variety of operational conditions. The purpose of this game is to allow air traffic managers to view bad weather scenarios, try out different responses, and view the consequences of their chosen response in fast-time. Figure 1 shows the NASPlay game interface.

In the current version of the NASPlay game, air traffic managers can experience several different historical bad weather days, including both the actual and forecasted weather as well as simulated traffic based on the particular day's schedule. At different points in the scenario "day," traffic managers are given the option to take action to reduce the traffic flow demand to accommodate the capacity constraints imposed by the weather. These traffic management initiatives (TMIs) include: (1) Ground Delay Progams (GDPs) that reduce flights destined to a particular

H.J. Davison Reynolds (✉) · R. DeLaura · B. Soulliard
MIT Lincoln Laboratory, 244 Wood Street, Lexington, MA 02420, USA
e-mail: hayley@ll.mit.edu

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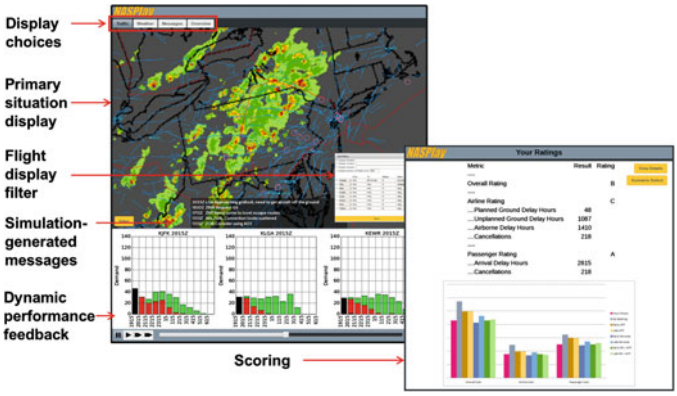


Fig. 1 NASPlay game interface

airport by delaying the flights at their departure airport, (2) Airspace Flow Programs (AFPs) that reduce the number of flights allowed over a line in the airspace by delaying the flights at their departure airport, (3) strategic playbook reroutes that move the flight plans of aircraft destined to a particular group of airports to a different part of the U.S., and (4) Ground Stops (GSs) that completely stop departures to a particular airport for a certain period of time. Options for time of implementation and rate requirement of the TMI are also provided. If the imposed TMIs still do not reduce demand to the actual capacity of the airspace, flights may respond by going into holding patterns at the point of constraint or diverting to other airports. Players are then "punished" for failing to correctly balance the demand to the capacity through the end of game score including both the actual delay numbers as well as a letter grade of "A," "B,", "C," "D," or "E".

For NASPlay to be used seriously by air traffic managers, the simulation needs to be a valid representation of the National Airspace System. Validation efforts commenced once initial functionality was present in NASPlay, including heuristic efforts and statistical efforts. However, the question that was faced during the development was, "How good is good enough?" In this paper, the validation methods used are described, including how the analyses changed with the evolving use case of the game.

2 Validation Approach

The validation approach taken in this program was a piece-wise iterative validation approach. As functionality was developed, an effort was made to determine whether the new functionality worked as it should. Depending on the functionality, the

validation effort took the form of visual, heuristic evaluation based upon the subject matter expertise of the developing analysts, statistical analysis that logically matched with the truth data of the historical NAS, or expert validation by air traffic controllers and managers. Some of the core functionality was validated in multiple ways.

The purposes for NASPlay development have expanded during its lifetime. An important discovery was that the validation requirements necessarily change with the evolution of the purposes. In the remainder of this paper, three separate NASPlay purposes were explored and the validation efforts that occurred within each development purpose are explained. At the end of the paper, the overarching lessons learned about the validation process will be summarized. The three developmental purposes include proof of concept validation, training prototype validation, and human-in-the-loop/system exploration validation.

3 Proof of Concept Validation

The initial developmental purpose for the NASPlay game was to implement a realistic NAS simulation and demonstrate a viable game architecture & interface.

3.1 Simulation Models

To accomplish this goal, several simulation models were required, including, most importantly, a flight model that ingested a NAS-wide flight schedule, determined takeoff time of individual flights, and then simulated these flights to their destinations. Another important model that was developed was a weather informed ATC sector capacity model that influenced the flights to go into "holding" patterns when encountering a sector that was at its set capacity. Other models that were developed within this initial purpose included an airport capacity model, a fix capacity model, and a winds model.

3.2 Decision Options

The initial decisions offered to the NASPlay player included an AFP (different times, rates), a single reroute, and a GDP for the New York metro airports.

3.3 Metrics

The first metrics collected from the gameplay included flight delay, holding time, hourly measurement of aggregate delay & holding, time of flight, fuel burned, and cancellations.

3.4 Validation Goals

The first validation goal of the initial prototype was to analyze the individual flight simulation model (altitude, speed, time of flight). In parallel, the weather avoidance model was also validated.

3.5 Flight Simulation

An initial evaluation of the key aspects of the core flight model was completed. Figures 2 and 3 show two examples of these analyses. Figure 2 depicts an initial comparison of simulated flight time with historical flight time for the same day. From this graphic, one can identify problems with the flights with lengthy travel times. For flights over 300 min, the simulated times are biased longer than their scheduled counterparts. This validation analysis identified two shortfalls, primarily associated with international flights: the need to adequately account for missing wind information and for improved flight planning rules over international airspace. Once these shortfalls were addressed, this bias was eliminated.

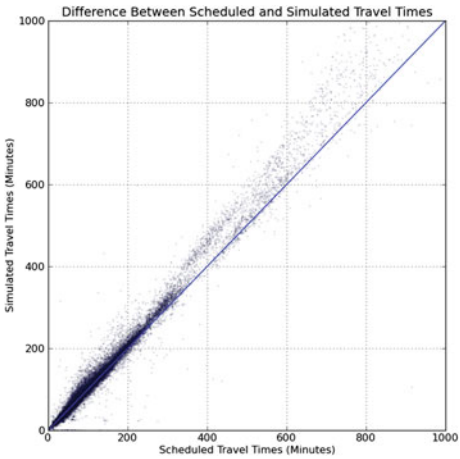


Fig. 2 Comparison of simulated and scheduled flight times for all flights

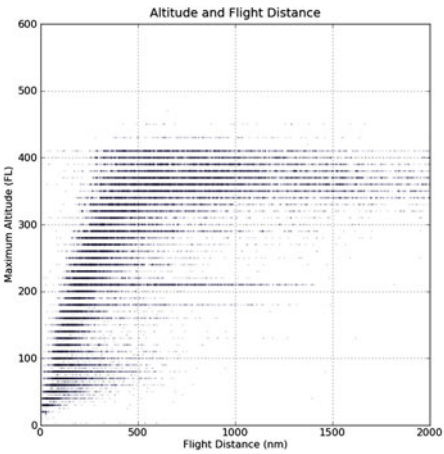


Fig. 3 Maximum altitude for a flight as a function of the aircraft's flight distance

Figure 3 depicts the maximum altitude for the simulated flights as a function of the aircraft's flight distance. One issue identified from this analysis was the problem that some flight plans did not register a desired altitude. Many of these simulated flights then defaulted to 21,000 ft, which is unusually low for long-haul flights. This resulted in high fuel-burn penalties in the scoring. The flight plans were then modified to associate more reasonable altitudes for long-haul flights. Additional analyses were performed on the adjusted models and data until the simulation yielded statistically reasonable results.

3.6 Weather Avoidance

For the initial validation of sector capacity models, the flights' weather avoidance behavior was visually evaluated by subject matter expert analysts with thousands of hours experience in observing historical flight weather avoidance. Visual evaluations revealed that the initial sector capacity models in the simulation did not constrain the sectors to the same extent that the actual weather did in reality. A reversion to a traffic-flow based capacity model was determined to be the solution for the next development cycle of NASPlay to yield more realistic results.

3.7 Expert Validation

Once the flight model was modified, the initial prototype was presented to a select set of air traffic controllers and managers to determine if such a game would be at all valuable to their work. They were asked if/how NASPlay could be helpful for their job and if so, what would need to be incorporated or fixed to meet that need.

Table 1 Initial concept discussion results from ATC experts

Expert	Information/functionality requested from NASPlay
ATCSCC training	Generation of many severe weather scenarios for NASPlay; Explore connecting NASPlay to existing Flight Schedule Monitor
ATCSCC traffic management specialists	Incorporate airline cancellations and pilot diversions into functionality; Make NASPlay multi-player and web-based for a single scenario
Manager of tactical operations in the northeast U.S.	Generate tactical scenarios for NASPlay focusing on a single en route center and/or TRACON; provide ability to continuously monitor airport surface status; Make NASPlay scoring consistent with the FAA's AERO operational evaluation statistics page
Former controllers	Incorporate airline cancellations, pilot diversions, tactical rerouting into functionality

Table 1 provides the results of this expert input. The game was discovered to be useful not only for the original purpose of training, but also for procedure development, decision support concept exploration, and day-after performance evaluation. Other simulation models were suggested by the experts to be incorporated into NASPlay, including enhanced cancellation and diversion models to better reflect the NAS.

4 Training Prototype Validation

The next iteration of NASPlay focused on continuing the training goal, providing several example historical strategic traffic management scenarios with realistic decision options and scoring that aligned with actual outcome and logical alternatives.

4.1 Simulation Models

In this development cycle the program sought to improve the holding locations of flights, implement an Approval Request (APREQ) capability to prevent flights from going into holding as soon as they departed, revert to a flow-based capacity model instead of a sector-based capacity model, implement an airline cancellation model, and implement a flight diversion model.

4.2 Decision Options

Players were given the options of additional GDPs, additional AFPs, multiple playbook reroutes, and GSs.

4.3 Metrics

To address the suggestions of the experts from the previous iteration, additional dynamic metrics were incorporated including airport surface metrics and the FAA's AERO metrics.

4.4 Validation Goals

The goals for this iteration were to ensure that the TMI were implemented correctly, the simulated NAS behaved logically (e.g. delay-inducing TMI resulted in higher ground delays than uncontrolled departure times when no capacity constraints are present), and that the delays resulting from the simulation mimicked the actual NAS behavior as closely as possible.

4.5 Air Traffic Management Initiative Validation

Multiple analyses manipulating the TMIs to gauge their behavior both with and without capacity constraints were performed. One example of such analyses is shown in Table 2. Table 2 depicts departure delay both with and without an AFP (rate of 50) in scenarios both with and without idealized capacity constraints that mimic weather impacts. AFPs are designed such that if one is in effect, flights are held on the ground to meet the constraint of the Flow Controlled Area (FCA) in en route airspace. Thus one would expect that in an AFP scenario, departure delays would be higher than in non-AFP scenarios, which is the case below. In addition, in constrained capacity scenarios, the capacity of the airspace is reduced even further, thus the weather scenarios should result in higher departure delays than the unconstrained scenarios, which is also the case.

Besides data-driven analyses, visual analyses were also used to validate TMI behaviors. One example is shown on the left in Fig. 4 in which a playbook reroute was implemented. The flights affected by the reroute were colored orange than the remaining flights, and in viewing the NASPlay simulation, one can see the rerouted flights actually divert from their original flight plan onto the new routes. The TMI validation verified that all three TMI had been properly implemented, and the validation also identified a shortcoming in the modeling of weather constraints

Table 2 Airspace flow program departure delay data (min)

	No AFP	AFP
Unconstrained (no weather)	200	485
Constrained (weather)	412	578

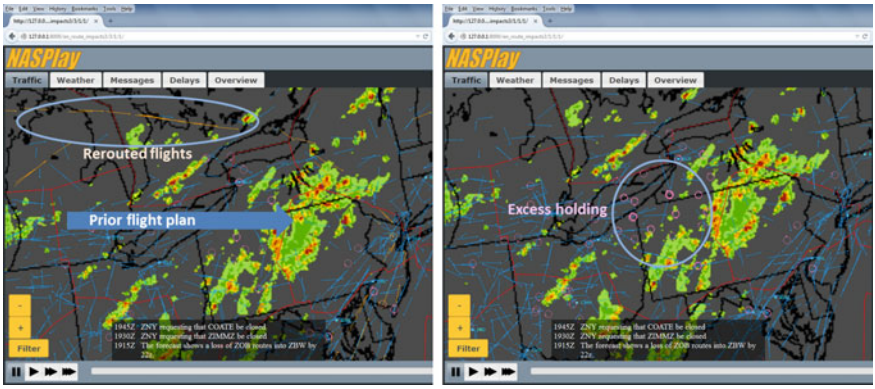


Fig. 4 Flights affected by CANADA (CAN) reroute on the *left*. On the *right*, the same flights in a different NASPlay simulation were sent into holding because of encountering the weather

through flow capacity. This shortcoming is currently being addressed as part of the next development iteration.

4.6 Scoring Validation

Once the multi-scenario iteration of NASPlay was developed, a second expert evaluation was conducted with traffic managers at the ATC System Command Center. As one of the questions, it was asked whether the scores and delay numbers seemed reasonable given their extensive experience. The surprising response from the traffic managers was that the actual score from NASPlay did not matter. What mattered to the traffic managers for training purposes was whether the information displayed had face validity, whether the relationship between traffic and weather was logical, and the whether the interactions between cause and effect (e.g. NAS system response to TMI decisions) could be examined and understood. Understanding that the absolute scores and results were not critical to the traffic managers was key in understanding the validation requirements of NASPlay for training purposes.

5 Human-in-the-Loop Experiments and System Exploration Validation

The newest evolution of purpose for the NASPlay game system is as a platform for human-in-the-loop experimentation and for better understanding the complexities of NAS behavior that will lead to the development of traffic management best practices. Both of these purposes have more stringent requirements as far as NAS

validation is concerned. Problems with the simulation models can have big impacts in HITL statistical analyses. Incorrect assumptions and models can also lead to development of incorrect practices. The program is currently in the midst of this development cycle, therefore final development and validation results are in progress.

5.1 Simulation Models

For this most recent iteration, the diversion model was fixed and tactical reroutes were implemented. In the previous iteration it was found that flow-based capacities did not completely solve the problem, therefore an improved sector capacity model is in development for use with the flow-based models.

5.2 Decision Options

No additional decision options were provided for this iteration.

5.3 Metrics

A more comprehensive set of simulation output data is required for HITL purposes. More sophisticated methods for the analysis of the expanded output dataset must be developed to assess NAS performance and to attribute aspects of NAS performance to specific player actions.

5.4 Validation Goals

In this iteration of NASPlay, there is interest in accurately capturing the impacts of decisions on the different stakeholders in the NAS. In initial validation exercises, it has been found that the impacts of different TMI decisions on traffic managers and tactical air traffic controllers have not been adequately captured. Thus, an explicit traffic management score must be defined and validated. Furthermore, as multiple stakeholder objectives are incorporated into the output dataset and comprehensive performance validation, models for airline decision making (e.g. flight cancellation) must be validated and refined.

6 Discussion

NASPlay operates at the intersection of three extremely complex systems: the National Airspace System (NAS), weather, and expert human world modeling and decision making. The number of possible interactions among the systems and the wide range of spatial and temporal scales over which the systems interact makes an 'airtight objective' validation impossible.

Figure 5 below depicts the validation process that was used throughout the development of NASPlay. The purpose drove the requirements identification. As the functionality was designed and implemented, piece-wise validation efforts took place. The results were evaluated and determined "acceptable" or "unacceptable" in the context of the intended purpose. If unacceptable, the simulation model was evaluated in order to identify the deficiency responsible for the unacceptable results. If a deficiency was identified, the model was modified and the validation process was performed again. If the deficiency could not be identified or could not be remedied, then the game realization was modified to de-emphasize the model deficiency, the concept for achieving the purpose was refined to minimize the effect of the model deficiency, or the purpose was set aside to be re-visited. At different stages in the game development, technological limitations may prevent the simulation from fulfilling its intended purpose, at least in the near term.

Determining the threshold for "acceptable" or "unacceptable" is ideally based upon the requirements of the game. Practically, it was determined by not only the requirements of the game, but also what model improvement options were conceived or available. One issue that was encountered in this process was that the truth data against which the simulation results were validated were commonly

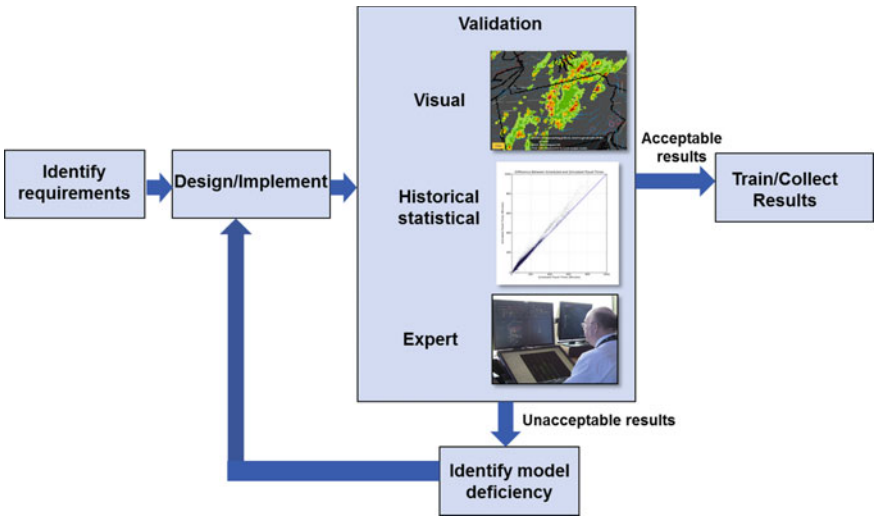


Fig. 5 Iterative validation model approach used in NASPlay development

found to be unreliable, making historical statistical validation difficult. In addition, the system itself contained noise, within which statistical validation results were acceptable. For example, the Federal Aviation Administration keeps track of time of arrival, but only considers flights late if they are late by more than 15 min. Thus, when validating time of flight, errors within 15 min were considered "acceptable" and not operationally significant.

This cycle of defining the purpose and requirements, design and implementation, piecewise validation, and flexible response to identified model deficiencies made it possible to progress and gain valuable insights even as flaws were identified and addressed. The alternative—a strict insistence that the simulation meet objectively defined criteria before proceeding to the next phase—would have proven infeasible. Indeed, in this case, the 'perfect' was not only the enemy of the 'good enough', but also would have a been a significant impediment to progress that has been made in addressing a complex and multifaceted problem.

Immersive Games and Expert-Novice Differences

Amanda J.H. Bond, Jay Brimstin and Angela Carpenter

Abstract Immersive game-based training has been used effectively for years to train within numerous domains. Immersive simulations and games, however, are frequently used to train at the pinnacle of instruction, though research shows that game- and simulation-based training platforms are consistently more effective than traditional training across all phases of instruction. Game-based training has potentially limitless variables on which training can be adapted: troops can change efficacy, weather can turn and equipment can malfunction. Understanding the relationships between adaptive variables is key to effective game design that distinguishes expert and novice performers for assessment. This paper describes the development of a simulation-based game using distributed concept maps for expertise categorization. The expert models were incorporated into a real-time strategy game intended for use to train and assess understanding of and adherence to Army doctrine. Preliminary validation data are also presented comparing the game to traditional Interactive Multimedia Instruction (IMI) courseware.

Keywords Serious games · Expert-novice differences · Adaptive training · Scenario-based training

A.J.H. Bond (✉) · A. Carpenter
Cubic Global Defense, Orlando, USA
e-mail: amanda.bond@cubic.com

A. Carpenter
e-mail: angela.carpenter@cubic.com

J. Brimstin
Maneuver Center of Excellence, Fort Benning, USA
e-mail: jay.a.brimstin.civ@mail.mil

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1 Introduction

Immersive game-based training applications have been used effectively for years to train within numerous domains. These games, however, and simulation-based training in general are most frequently used to train at the pinnacle of instruction, once the part-task trainers have been mastered and knowledge-based instruction has been acquired, particularly in the Department of Defense. The games are therefore used at the "run" stage of instructional development, when mastery of the basic knowledge and skills is presumed, and the simulation-based learning platform becomes a conduit for performance practice and assessment rather than knowledge acquisition. Beginning learners are not frequently afforded the opportunity to learn in a game-based learning environment from the ground up—through crawling, walking and running. One of the most difficult challenges to providing a one-size-fits-all solution is in providing an adaptive learning environment, in which learners' current knowledge and skill characteristics can be identified; thus, allowing the learning experience to be adapted and providing each learner with an experience tailored to their particular level of expertise. Identifying initial existing knowledge is frequently thought of as the most critical piece of the overall pedagogical paradigm [1].

Even TRADOC Pam 525-8-2, U.S. Army Learning Concept for 2015 [2] indicates that instruction must account for prior knowledge and experience. This paper describes the use of immersive game-based learning as a starting point to categorize expert and novice performers and provide adaptive training based on the individual level of expertise, as well as to evaluate expert, intermediate and novice performance. This project explored the use of an immersive training game to provide the indication of current knowledge and skill characteristics as a component of the game rather than a pre-test or demographic data point. This paper describes the methods used for expert and novice categorization along a spectrum of performance and the validation of the categorizations. Further, it explains how the scenario design supported the assessment of participants and how the scenario was then dynamically adapted based on the categorization of the participant, with the ultimate goal of challenging each participant through an experiential learning activity.

1.1 Immersive Games for Training

The common definition for a game is an interactive, intrinsically-motivating, rule-governed experience through which an individual progresses to achieve some goal. That goal may be simply to pass a level, or to pass a level with the most points, or complete some task in the longest (or shortest) amount of time. Since computers became prevalent to most schools and homes, games have been used to deliver training for tasks from Number Munchers [3] for addition and subtraction, to geography as in 'Where in the World is Carmen Sandiego' [4]. Previously called "edutainment," the moniker "serious games" has become more prevalent since the

games themselves have become more immersive, realistic and cognitive complex and less focused on "drill and practice" mechanisms for game play [5].

Three distinct areas compose game-based training: entertainment games, models and simulations, and learning science. A simulation with a realistic scenario and well-organized training objectives but without a story or motivating reward structure as found in entertainment games is not game-based training. Likewise, a game that has high levels of simulation and visual fidelity and an engrossing story, but does not deliberately teach, assess and remediate task performance is not game-based training. Serious games for immersive training only occur when all three aspects are present [6]. Immersive games do also require different types of authenticity, pending the type of task being trained. Gopher, Weil, and Bareket [7] trained Israeli Air Force cadets using a shooting-style video game with extremely low physical fidelity but with commensurate cognitive task fidelity. The tasks within the game that the cadets performed greatly mimicked specific maneuvers and procedures related to flying jets, but the game itself was an arcade-style game, not a high-fidelity flight simulation. During test flights in a jet trainer, the group that trained with the arcade-style game outperformed the group trained using traditional training methods.

Game- and simulation-based training have shown to be consistently more effective than traditional instruction, with approximately 66 % of trainees learning more in games and simulations (e.g., [8]). Stizman [9] found that game-based training increased self-efficacy of learners by 20 %, increased declarative knowledge by 11 %, increased retention by 9 % and increased procedural knowledge by 14 %. Although developing immersive games for training can be more costly upfront, game-based training results in higher learning gains overall and better training retention compared to traditional training. Serious games, therefore, are widely used because they are inherently motivating (e.g., [10]) and engaging [11], which encourages trainees to complete more training because they are motivated to play the serious game over and over again. In addition, new and emerging technologies allow trainees to access training from multiple locations and platforms, from a personal smart phone in a forward-deployed Soldier's pocket, to a large cave automatic virtual environment (CAVE) in a traditional schoolhouse. Having the serious games widely available and easily accessible increases the effectiveness of the game-based training [9].

1.2 Adaptive Training and Experiential Learning

Game-based training can also be used to train a wide variety of skills simultaneously, and can be tailored for individuals, allowing them to focus on areas where they need the most help or practice. The tailoring can happen through the provision of multiple scenarios and iterations of scaffolded experiences, for example, or it can happen real-time through adaptive training. A real-time adaptive training program, whether within the construct of game-based learning or not, can be a very efficient method of delivering training, as the student is able to learn the items he or she most

needs in the style that is most appropriate. In their review of adaptive game-based learning paradigms, Soflano et al. [12] do note that empirical research is still lacking with respect to the validation of specifically adaptive training games, and their effect on learner experience is not yet conclusively known. Generally, however, it is accepted that adaptive instruction improves cognitive development by addressing individual differences in learners (e.g., [13]).

The variables on which training can be adapted based on learner progress and performance are broad and varied. Soflano et al. [12] add specific variables for adaptation within a game-based learning environment, including feedback, content sequencing, and scaffolding. The player's character can be modified in ways such as having better health or knowing additional skills such as jumping and somersaulting. The non-player characters within the game can be adapted to react to and help or hinder the learner based on learner inputs, dialogues, and actions. The game environment itself can be adapted with respect to improvements and decreases to weather, controls, and tool. Finally, the feedback and scaffolding can be adapted to provide more or less guidance to the learner as appropriate. In immersive games, the additional adaptation possibilities are as complex and varied as the context within the game itself. The game can also become harder overall, with more variables in general for the learner to consider related to their decision-making, or it can be tailored more specifically to the specific knowledge enabling learning objectives on which the learner may be displaying difficulty. For example, a hospital emergency room training game that requires a learner to triage patients quickly, efficiently and correctly may increase the frequency of the patients presented to invoke more stress and better decision-making strategies. Perhaps the game may also present patients with increasingly complex problems if the learner is showing poor attention to detail, or present increasingly uncommon conditions if the learner is obviously well-versed in how to triage most common emergencies. Of course, adaptation that is more traditional can also occur, such as increasing scaffolding hints, providing more immediate feedback and providing overview information to the learner.

An adaptive learning environment, however, should not only assess and react real-time to the learner's knowledge, skills and/or abilities within the game-based training, but should also assess the individual learner to understand their *incoming* level of expertise at the beginning of the training [1] in order to tailor the educational experience at the onset. This is contrary to typical deployment of immersive games, however. Traditional edutainment games are set for very specific ages or levels of prior knowledge, such as the grade-school edutainment games of the 1980s and 1990s as mentioned. On the other end of the spectrum, the immersive simulations within the Department of Defense are typically used at the pinnacle of training, as an application of knowledge, such as when fighter jet pilots move up from practicing skills in various part-task trainers to combining the various skills and knowledge within a fully-immersive flight simulator. In traditional training environments, assessment of prior knowledge is accomplished using a pre-test to classify learners or ensure learners have the requisite pre-existing knowledge in order to succeed within a course, however even then the training may not be

tailored to the individual levels of skills (e.g., [1]). Even then, an immersive training game (or training simulation in the absence of serious game qualities) is often used to perform tasks that have been taught to them in ways that are more traditional; that is, the technology is a means to elicit performance practice and assessment of knowledge, skills, and abilities, not teach the knowledge, skills, and abilities.

Providing an adaptive learning environment within an immersive training game affords a supreme opportunity for experiential learning. Experiential learning is a repeating cycle in which the learner has a concrete experience and has opportunity to reflect upon that experience [14]. Upon reflection, the learner then can conceptualize in abstract ways the relationships between the variables within the experience, such as how their decisions affected the outcomes. The learner then has opportunity to repeat the same or a similar concrete experience, and conduct active experimentation to test new theories, expanding upon their organizational schemas of prior knowledge. Learners are able to have this experience within the context of the topic by interacting with relevant objects within a potentially complex environment in the training game, exploring concepts and achieving goals along the way.

It is important to note that experiential learning does put considerable onus on the learner, as they must first be willing to be actively involved in the experience. This is one avenue in which an immersive training game provides a great boon—because the games are inherently motivating, the learner is much more likely to be an active participant in their learning. The learner however must also be able to reflect on their experience, impartially analyze their experience through metacognition, and display problem-solving skills to apply new theories and knowledge appropriately [14]. These thought processes, however, could be facilitated through gameplay with feedback, debriefing screens and after-action reviews, and self-reflective prompts such as calling out specific characteristics of the experience.

1.3 Expert-Novice Differences

One challenge in creating adaptive learning is in accurately and with appropriate levels of detail identifying the characteristics of learners at particular levels of expertise [1]. Kim [15] explains that specifically the development of an expert mental model to use as a yardstick, upon which other learners are assessed, particularly within a complex problem-solving paradigm, is one of the three main complications to creating adaptive learning. Mental models are representative cognitive artifacts that describe how information is conceptualized, aggregated, organized and stored within the human memory. Their schemas evolve and grow as the learner gains more experience, as is the case with experiential learning. Mental models also provide a way to conceptualize the building of expertise. Spector and Koszalka [16] define three specific characteristics of mental models that are descriptive of the experience of the learner: surface, structure, and semantic features. The surface features are those that are salient, that categorize objects and ideas into definitions and relationships. The structure features describe the overall

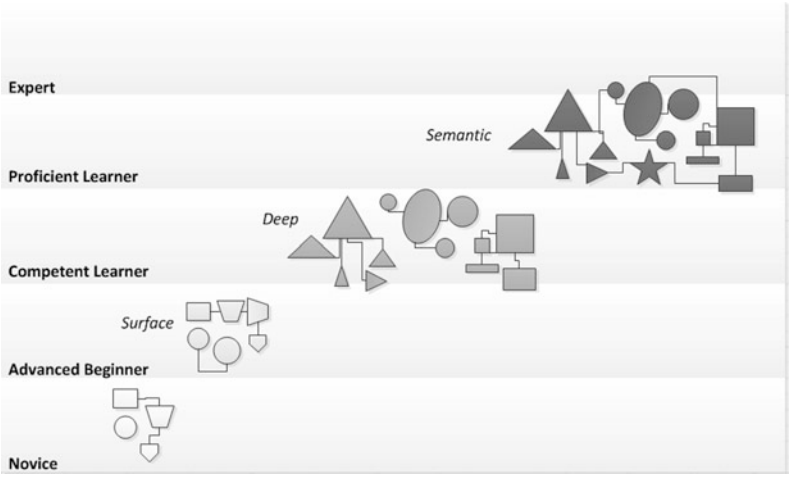


Fig. 1 Features of mental models at different states of proficiency (*left*) and characteristics labels. Adapted from [15, pp. 609]

size and complexity of the mental model as a whole, linking key concepts and exemplifying deep knowledge on a topic. The semantic feature describes the conceptual levels of understanding about two or more concepts, particularly on the deep structural level, as the concepts relate through laws, policies, attributes and conditional if/then scenarios (see Fig. 1).

Cognitive task analysis is suggested as one way to ensure that game-based learning appropriately represents the cognitive features of a game (e.g., [17]), and is also one way to elicit the knowledge of experts [18]. Cognitive Task Analysis (CTA) is a methodology for knowledge elicitation in which practitioners—typically researchers such as cognitive scientists—aim to understand the complexities and dependencies of sociotechnical systems, including cognitive processes and decision-making. For this reason, many CTA methodologies center on a problem statement or the recall of a specific problem that was solved previously (generally a CTA is performed with an expert in the field of study). Relevant to the idea of mental models as measurable artifacts of expertise, however, is the concept map as a method for CTA. Concept mapping is an exercise also done by a researcher, but it not only captures the knowledge elicitation data but also represents it real-time for the expert. This provides a level of metacognition about the topic and is both an efficient and effective methodology for expert knowledge elicitation. Concept mapping can be done on a white board, or with Post-It notes on a wall (allowing concepts to be easily maneuvered from one area of a concept map to the other), or with CMap Tools, which is a free software suite authored by the Institute for Human Machine Cognition.

In addition to eliciting knowledge, Novak and Cañas [19] discuss the utility of using concept maps for measuring deep knowledge of individuals as well as methodologies for comparing an expert concept map to other concept maps. Using

cognitive maps to define levels of expertise dovetails with Kim's [15] delineation of measurable attributes of learners at various tiers of expertise based on mental model features. Concept map mental models of experts can be used to inform the design of adaptive training including game-based training, providing surface features, structure features and semantic features to the overall understanding of a concept or system. In addition, just as the mental models can be measured on their features, the concept maps can be measured on their features to provide levels of expertise.

2 Interactive Game-Based Learning for Experts and Novices

The United States Army strives to provide exceptional training to Soldiers in a global and dynamic environment. To this end, the Army solicits industry to investigate ways in which the state-of-the-art training can be advanced to enhance further Soldier training and capabilities. The Maneuver Center of Excellence (MCoE) at Fort Benning, Georgia with Cubic Corporation is currently generating preliminary models of multiple mobile, accessible and scalable technologies to put the power of engaging training in the Soldier's hands anytime, anywhere. One of these exploratory samples is an immersive, adaptive game-based learning environment. The charter is to identify if one immersive training game can provide effective, adaptive training for both experts at the "run" stage in the "crawl-walk-run" learning paradigm, and advanced beginners, who are in the "crawl" and/or "walk" stages of learning. To accomplish this, the sample product has to have game features such as a story, motivational aspects, etc. The product also has to provide excellent learning opportunities, presenting terminal and enabling objectives and exemplifying the relationships between the objectives. In addition, the product must appropriately assess the learner—and in this case, asses the learner not just on overall performance, but also on real-time performance to provide an adaptive, customized experience. Finally, the product should include simulation of the task at the appropriate level of fidelity—for our purposes, this manifests as a real-time strategy game, mimicking an offensive mission.

2.1 Game Play and Story

Game-based learning focuses on the Army Techniques Publication (ATP) 3-90.1: Armor and Mechanized Infantry Company Team [20]. This publication provides doctrine techniques for mechanized Infantry and Armor company teams within combined arms battalions. It is intended for leaders at the company level to provide guidance and doctrine on the planning and execution of offensive, defensive, stability, and sustainment operations. Specifically, the game focuses on Chap. 2 of the

publication: offense planning and execution. The scenario is a movement to contact in the fictional land of Atropia, and an operational order (OPORD) has been issued. The player's job is to form a plan and execute the movement to contact across a wide battlespace. Along the way, the player may encounter various enemies, direct fire, indirect fire, ambushes, obstacles and other factors around which their plan will have to adapt and change. Some basic plans are provided in the OPORD with respect to phase lines, objectives, rules of engagement, and METT-TC factors. METT-TC factors (Mission, Enemy, Terrain and weather, Troops and support available, Time available and Civil considerations) are factors which along with the commander's intent, the current company status (slant) and rules of engagement, are critical considerations in order to succeed in any mission, and as such are the foundation of ATP 3-90.1.

To play the game, learners first receive a brief on the requisite METT-TC considerations and the OPORD. This all happens on the mobile platform itself. Learners then are asked to set up an initial plan for their Company; other intelligent agent Companies are present within the battlespace. As the learner starts to execute the mission, he is prompted to make decisions along the way—for example, one Company may arrive at a phase line earlier or later than planned; the learner must then decide how to handle the situation with respect to time, tempo, formation, the other units and other considerations.

2.2 Game Instructional Approaches and Adaptation

There are several instances in which the learner can completely lose the game, but the game largely progresses along the path towards the objective, with the game assessing the learner at every trigger as well as multiple other points within the game. The assessments are weighted and decisions are ranked and awarded points based on their appropriateness for the decision. Additionally, the assessments are made against specific considerations, enabling objectives, and variables relevant to METT-TC decision-making; these variables include friendly variables, hostile variables and environment variables. Examples of friendly, enemy and game environment variables that are adapted are outlined in Table 1.

Table 1 Example game variables that can be adapted to suit player ability

Friendly variables	Enemy variables	Environment variables
Indirect fire effectiveness	Indirect fire effectiveness	Civilians
Indirect fire reaction time	Indirect fire reaction time	Precipitation
Combat power	Armor effectiveness	Visibility (fog, smoke)
Fuel	Power (damage)	Wind
	Weapon effectiveness (accuracy)	Cloud cover/Ceiling
	Attack intensity (frequency)	Time
	Indirect fire effectiveness	Civilians

In addition, the player is assessed on overall mission success, on communication (they are expected to provide reports indicating current combat power at least every hour, for example), and adherence to commander's intent and rules of engagement. When each decision is scored, the game can then appropriately scale the game by removing or adding specific features based on the game variables; for example, failing to consider terrain and weather when implementing the next movement technique and formation could back off the weather factors within the game. In this way, the learners all receive a customized experience. The only feedback the learners receive is the in-game feedback of the variables shifting based on input. There is no feedback on performance indicating right or wrong choices, which they may want to consider other options, etc. Once the player completes the game (or the game ends), the game-based learning provides an after-action review detailing the choices the player made specific to each game variable and the impacts of those decisions. In this way, the game provides prompts and data for metacognition in order to foster experiential learning in the player.

2.3 Defining Levels of Soldier Expertise

In order to generate the appropriate storyline, variables, conditions for the game and most importantly to ensure appropriate mapping between learning objectives and game variables, Subject Matter Experts (SMEs) provided inputs and feedback on content as well as what an expert model looks like for the game. In addition, in order to execute the real-time assessments and grade them accordingly, the SMEs provided their mental model of the offensive movement to contact mission with respect to METT-TC factors, doctrine, rules of engagement and commander's intent. This was accomplished using a concept map (in CMap Tools). The initial SME-generated concept map was then used as a baseline to elicit more feedback from additional Soldiers with varying levels of experience, such as Small Group Instructors at the MCoE and new and existing students in the Maneuver Captains Career Course. As such, the initial SME concept map was modified slightly to engage participants, and the aforementioned Soldiers were asked to provide feedback on the concept map. Feedback was provided by drawing additional lines, relationships, hierarchies and concepts, as the Soldiers understand them, and by crossing out connections and concepts that they do not feel less-experienced Soldiers always consider (or that they did not consider if they are less-experienced Soldiers). Participants also filled out a demographics form. This provided the game development team with further weighting feedback and adaptation feedback to know how best to customize the game for various levels of expertise.

Eleven participants provided feedback on a concept map set representing the knowledge and topics covered in Chap. 2 of the ATP, the main content of the game. Participants clearly fell into two experience groups: those with five or less years of experience, and those with nine or more years of experience. Because of the relatively low number of participants, we only classified into two groups of

Table 2 Summary of experience differences between concept mapping participants

Criteria	More experienced	Less experienced
Prior service	9–11 years	4–5 years
Instructor experience	All	None
CTC rotations	Up to 18	At least 1
Prior leadership	Teams of teams	Small groups
Deployments	Multiple	At least 1

participants: more and less experienced. As expected, more experienced Soldiers had seen more rotations and had occupied leadership and/or instructor positions whereas less experienced Soldiers had not. Table 2 summarizes the differences.

Thirty-three variables were added to the concept maps, with more-experienced Soldiers adding 28 of the variables. Less experienced Soldiers identified nine variables to add to the concept maps, four of which overlapped with those provided by the more-experienced Soldiers. Less experienced Soldiers identified more variables—all nine—that they felt were not necessary to the planning or execution of a movement to contact, further anecdotally confirming they were less experienced. One more experienced Soldier noted one variable that he did not feel was necessary to the planning or execution of a movement to contact, and that variable was previously identified by the less experienced group. Based on the feedback provided by the participants, we were able to tailor game such that if a player missed one of those variables identified by the less experienced Soldiers as not critical, we could then lower the difficulty of the game across multiple variables. In this way, the player would be able to maintain engagement and continue the game without becoming too frustrated.

One lesson learned from using distributed concept mapping is that we were not able to assign orders of magnitude to variables and criteria in order to identify good-better-best decisions, criteria or outcomes. One way we anticipate handling this in the future is to create an appended concept map and ask both more and less experienced participants to rank-order child nodes off any parent node. We would then run simple statistics to determine the more intricate levels of the adaptive learning and assessment. For this project, our SMEs provided us with the required good-better-best rankings and scorings based on the updated concept map with participant input.

3 Preliminary Results

The MCoE and Cubic Corporation conducted a pilot validation study to understand the effectiveness of the game at identifying various levels of expertise, of providing a customized experience for the learner, and of providing experiential learning. In addition, the game itself was investigated for playability and engagement as well as its workload imposition on the player. Nine participants tested the game. The participants supplied by the MCoE were varied in experience, though all nine held the rank of Captain (CPT). All participants but one had taken the Captains Career

Course. One-third of the participants had previous experience as an Instructor or Observer/Controller, and all individuals had prior leadership experience. The leadership experience identified included Platoon Leaders, Squad Leaders, Executive Officers, Commanding Officers and Company Commanders. On average, the participants had participated in over five Combat Training Center (CTC) Rotations (although two outliers with 22+ Rotations pulled up the average; most had 1–4 Rotations), had deployed almost two times to a theater and the average time in service (including time in ROTC) was six years.

All participants owned a personal smart phone, and six participants had personal tablets. Five participants played games on a console device, four participants played games on their computer and six participants played games on their smart phones. Only two (2) participants played games on their tablets, and five participants used electronic reading devices. Three participants preferred consoles as their gaming platform, while two preferred personal computers.

3.1 Method

The game-based training participants were compared to another group who also took a two-day course on the same ATP. The course was self-study in-class and provided via IMI, and the training and testing were conducted during the same validation period. After completing the IMI course, the IMI participants were then given the training game to play. Following the training game, IMI participants received a scenario-based posttest. The training-game only group received the identical multiple-choice pretest prior to playing the training game. Following the training game (after approximately 2 h), the game-only group took the identical scenario-based posttest. Both groups were administered the identical tests, in the identical order. That is, they were both given a multiple-choice pretest prior to playing the game. After they had played the game multiple times, they were given the multiple-choice posttest and the scenario-based posttest. Both groups also took demographics questionnaires as well as usability surveys regarding the product(s).

3.2 Results

Unfortunately, due to a previously unidentified bug in the after-action review software, we were unable to ascertain the levels of passing or scores for participants who played the game. However, based on test scores, we were able to identify that at least anecdotally, learning could be occurring and further investigation is warranted. Though there was insufficient data for conclusive results, both those who took the IMI and those who only played the training game showed similar gains for Chap. 2 (as well as Chap. 1, which was also relevant to the training game). Chapters 1 and 2 were the highest posttest scores overall for the training game only participants as

Table 3 IMI participant pre/posttest scores compared to game-only participant pre/posttest scores

Ch.	IMI pretest (%)	IMI posttest (%)	Delta (%)	Game pretest (%)	Game posttest (%)	Delta (%)
1	49.3	62.8	13.5	59.3	70.4	11.1
2	50.6	63.2	12.6	57.1	70.6	13.5

well, indicating learning could be occurring specifically for those chapters as they relate to the game (other scores tended to have stasis or even decrease pre-to-post). See Table 3 for details.

4 Discussion and Next Steps

Game-based training is a growing area that has the capability to improve greatly the way we conduct training. This includes the investigation of how to use game-based training throughout the learning cycle rather than exclusively at the peak of instruction testing individuals who are assumed to have mastered the basics. The challenge of creating an immersive training game that can be used by learners at varied levels of experience, however, is in having the adequate levels of variables with appropriate relational distinctions and rankings (i.e., good-better-best). The authors feel that distributed concept maps provided an excellent first step to obtaining expert-novice and variable information; however, we have lessons learned and ways to improve our process such that we can obtain order of magnitude, importance and criticality rankings from the participants while using the same (and updated) concept maps.

Though the pilot validation did not afford statistically significant results, we do feel that the results showing similar increases for both participants who did and participants who did *not* receive traditional instruction prior to playing the training game indicates that more studies on this should be conducted in the near future.

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References

1. Shute, V.J., Zapata-Rivera, D.: Adaptive educational systems. In: Durlach, P. (ed.) Adaptive Technologies for Training and Education, pp. 7–27. Cambridge University Press, New York (2012)
2. Department of the Army: The U.S. Army Learning Concept for 2015 (TRADOC Pamphlet 525-8-2). Headquarters, United States Army Training and Doctrine Command: Fort Monroe, Virginia (2011)

3. Minnesota Educational Computing Consortium: Number Munchers (1986)
4. Borderbund Software: Where in the World is Carmen Sandiego (1985)
5. Charsky, D.: From edutainment to serious games: a change in the use of game characteristics. Games Culture **5**(2), 177–198 (2010)
6. Cannon-Bowers, J.: The way ahead in game based learning. Paper presented at the Defense Game Tech Users Conference, Orlando, FL (2010)
7. Gopher, D., Weil, M., Bareket, T.: Transfer of skill from a computer game trainer to flight. Hum. Factors **36**(3), 387–405 (1994)
8. Wouters, P., van Nimwegen, C., van Oostendorp, H., van der Spek, E.D.: A Meta-Analysis of the cognitive and motivational effects of serious games. J. Educ. Psychol. **105**(2), 249–265 (2013)
9. Stizmann, T.: A meta-analytic examination of the instructional effectiveness of computer-based simulation games. Pers. Psychol. **64**(2), 489–528 (2011)
10. Reiber, L.P.: Seriously considering play: designing interactive learning environment ased on the blending of microworlds, simulations, and games. Educ. Tech. Res. Dev. **44**(2), 43–58 (1996)
11. Girard, C., Ecalle, J., Magnan, A.: Serious games as new educational tools: how effective are they? A meta-analysis of recent studies. J. Comput. Assist. Learn. **29**(3), 207–219 (2012)
12. Soflano, M., Connolly, T.M., Hainey, T.: An application of adaptive games-based learning based on learning style to teach SQL. Comput. Educ. **66**, 192–211 (2015)
13. Lee, J., Park, O.: Adaptive instructional systems. In: Spector, J.M., Merill, M.D., van Merrienboer, J., Driscoll, M.P. (eds.) Handbook of Research for Educational Communications and Technology, pp. 469–484. Routledge, Taylor & Francis Group, New York (2007)
14. Kolb, D.A.: Experiential Learning: Experience as the Source of Learning and Development. Prentice Hall, Englewood Cliffs, NJ (1984)
15. Kim, M.K.: Theoretically grounded guidelines for assessing learning progress: cognitive changes in ill-structured complex problem-solving contexts. Educ. Technol. Res. Dev. **60**, 601–622 (2012)
16. Spector, J.M., Koszalka, T.A.: The DEEP methodology for assessing learning in complex domains. Final report to the National Science Foundation Evaluative Research and Evaluation Capacity Building, Syracuse University, Syracuse, NY (2004)
17. Tobias, S., Fletcher, J.D.: What research has to say about designing computer games for learning. Educ. Technol. **47**(5), 20–29 (2007)
18. Hoffman, R.R., Lintern, G.: Eliciting and representing the knowledge of experts. In: Ericsson, K.A., Charness, N., Feltovich, P., Hoffman, R. (eds.) Cambridge Handbook of Expertise and Expert Performance, pp. 203–222. Cambridge University Press, New York (2006)
19. Novak, J.D., Cañas, A.J.: Theoretical origins of concept maps, how to construct them and uses in education. Reflecting Educ. **3**(1), 29–42 (2007)
20. Department of the Army: Armor and Mechanized Company Team (Army Training Publication 3-90.1). Headquarters, Department of the Army: Washington, DC (2002)

Part XIII
Organizational Learning and Performance Management

Change Agent Infrastructure (CHAI)—A Stakeholder Analysis Tool for Ergonomics- and Work Environment-Related Change Projects

Cecilia Berlin, Jonatan Berglund and Erik Lindskog

Abstract This paper is a short communication introducing a novel method for stakeholder analysis, Change Agent Infrastructure (CHAI). The method is specifically developed in the context of ergonomics/work environment-related change projects and is meant for early stages of change projects. It maps potential stakeholders against eight distinct "roles" that have been found in previous research to facilitate or hinder workplace change. Mapping the "decision dilemmas" that stakeholders may face, as well as identifying over- or underrepresented roles, may benefit the change project in terms of determining information needs and how the project team should be staffed. The method has been iteratively developed and tested in educational and research projects. The method is visual, participative and helps to clarify the various participants' understanding of the change at hand and what it means for them—this contributes positively to information strategies and decisions that facilitates the planning and execution of a sustainable change.

Keywords Stakeholder analysis · Participative ergonomics · Method · Change processes · Case study

1 Introduction

This paper is a short communication introducing a novel method for stakeholder analysis (SA), specifically developed in the context of ergonomics/work environment-related change projects in manufacturing industry. The method is

C. Berlin (✉) · J. Berglund · E. Lindskog
Department of Product and Production Development, Division of Production Systems, Chalmers University of Technology, Hörsalsvägen 7A, 41296 Göteborg, Sweden
e-mail: cecilia.berlin@chalmers.se

J. Berglund
e-mail: jonatan.berglund@chalmers.se

E. Lindskog
e-mail: erik.lindskog@chalmers.se

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meant as a participative team exercise for early stages of change projects, and offers a visual and analytical procedure to map out the interactions of different stakeholders as they engage in and influence a change project.

1.1 Participative Workplace Change Processes

It would seem that any human factors/ergonomics (HF/E) change process benefits from the timely involvement of relevant stakeholders, many of whom can be identified using one of many existing SA methods, which often have their roots in management literature. Particularly for workplace change projects that affect many people, a participative process is often recommended due to the importance of securing buy-in from affected stakeholders, and thus it seems advisable that several people should be involved in determining who the most important stakeholders are. Carayon and Smith [1, p. 659] suggest that in order for changes to be sustainable (as in long-lasting), participation and learning (individually and organizationally) are critical aspects.

Due to the fact that many workplace interventions evolve into a *change project*, the intervention may be perceived as having beneficial effects for some stakeholders, while others may be uncertain about its outcomes, and yet others may regard it as disruptive to their operations, which may result in negativity and resistance. Therefore, this paper adopts an underpinning view of stakeholders as "political reflective navigators" [2, pp. 45–46] i.e. agents with differing motivations and goals to pursue as they perform "organizational work" [3]. Making H/FE improvements to workplaces tends to be political, as it is carried out in the interface between many interests, represented by different people with specific tasks to carry out in the organization. Also, in some organizations, some stakeholders may take on several roles at once; in such cases there is a risk for conflicts of interest for one and the same stakeholder, which may complicate (and consequently delay or hinder) decision-making and implementation of solutions. Therefore, understanding the motivations and roles of different stakeholders, in relation to the problem being addressed by the change, is crucial to ensure an effective change process and to secure involvement and buy-in of key actors.

However, some existing SA methods can limit the understanding of how complex the relation of each stakeholder is to the change project; many simply sort stakeholders into categories of high or low interest for management, based on three or fewer characteristics, like power, interest and need. Other methods rely on time-consuming, qualitative methods like interviews and focus groups, which require more interpretation and pre-necessitate that the stakeholder analyst knows who to involve in the first place. Therefore, the challenge that remains is to first correctly identify stakeholders who would be influential on and/or influenced by the particular change project. That in turn leads to determining whose active involvement would have the greatest impact on ensuring the project's successful planning and completion. What is needed is a pragmatic method that takes into consideration

that stakeholders do not always relate to a problem in a linear, cause-and-effect manner, but may sometimes have to take on several potentially conflicting roles at the same time as they navigate their stance on the upcoming change.

1.2 Stakeholder Analysis Methods

Existing methods for SA are often targeted at distilling a complex organizational reality into a graspable picture of who is involved in a situation where something is "at stake". The existing flora of recognized SA methods mostly stems from management science, and techniques can be distinguished into *descriptive* (purely describing relations between the stakeholders and the problem), *normative* (aiming to involve stakeholders) or *instrumental* (aiming to influence stakeholders), and according to the typology described by [4]. Existing methods for SA vary a lot in how formalized they are, but at their extremes, tend to either require a lot of interpretation beyond the classification offered in the methods' procedure, or they presuppose a certain type of "conflict" potential.

In many methods, dimensions like Influence, Power, Needs, and Interest are commonly the "axes" along which identified stakeholders are sorted. Many methods are tailored to a managerial (rather than collegial) perspective of "who needs most attention from the manager?" [5]; therefore the SA's goals have typically concerned the identification of cooperators or threats [6], and ranking of stakeholders in order of importance [5, 7]. The rationale for the prioritization is to avoid overly time-consuming and costly processes of involving all stakeholders; instead, efforts and resources are concentrated to the ones whose involvement will "yield" the most, according to the Manager's interpretation. However, in a participative workplace change process, understanding the intricacies of *how* and *why* may be a better support for discussion and decisions than only knowing *who.*

1.3 Manufacturing Change Projects

The method described in this paper has its empirical origins in change projects targeting work place design and ergonomics in manufacturing systems. Change projects in manufacturing systems can be initiated by many different triggers or problems [8], e.g. engineering changes to the product, quality issues, new laws and regulations; or they can be the results of continuous improvement work. Regardless of the nature of the trigger, the projects will, to some extent, affect the physical work that is performed in the manufacturing system. Smith and Carayon-Sainfort [9] define five elements that make up the manufacturing system: the individual, task, tools and technologies, physical environment, and the organization. Accordingly, one or more of those elements is likely to be affected by a change project. Such a change can be achieved in a direct manner by altering e.g. the work

task design, through training of operators, or by modifying or adding support equipment and tools. Alternatively, the effect can be achieved by physically reorganizing the work place to prod or pull the work tasks in a beneficial direction. Improvements can be either from a work ergonomic point of view and entail factors such as repetitiveness, force, poor workstation design, and unhealthy postures [9]. Improvements can also target productivity related factors such as quality, material handling efficiency, production rate, and delivery precision.

2 Change Agent Infrastructure—the CHAI Method

The following sections introduce the theoretical basis, structure and use procedure of the method *Change Agent Infrastructure*—CHAI for short.

2.1 Theoretical Basis and Development

The idea behind CHAI is rooted in research about how workplace change agents (e.g. ergonomists, industrial engineers, health and safety specialists etc.) relate their role and their actions to the issue of changing workplaces to benefit HF/E, primarily in a manufacturing setting. This research has emphasized the persuasive and political role of the workplace change agents [2, 3, 10, 11] and was consolidated in a thesis into a methodological framework for workplace change agents to individually map out their "Ergonomics Infrastructure" [12]—the term infrastructure signifying their possibilities for influencing other stakeholders to advance an ergonomics agenda. The method involved a seven-step process that included stakeholder identification, problem formulation, problem relations, a hierarchical organizational sorting and an analysis of power bases [12].

The method was subsequently tested on undergraduate and graduate student projects in workshop format at three Engineering Universities in Sweden by the main author. After some evaluations and iterations, the method was modified to demand less time, function more as a participative method, and provide a more concentrated workshop focus. This was achieved by slimming it down to only the first four steps found in [12], elaborating with more stakeholder categories (or "roles"), and drawing more attention to the quantification of how many actors are enacting each role.

2.2 The Method: Roles that Help Identify Actors

The novelty of the CHAI method is based on an identification and characterization of stakeholders as belonging to eight non-exclusive categories (or "roles") in

relation to a proposed change: *initiators, sponsors, subjects, documenters, convincers, change owners, solution builders* and *blockers* (Table 1). Each category defines typical actions taken by the stakeholder(s), allowing for identification of stakeholders based on a task-level approach that is independent of organizational title, departmental belonging or criticality based on the dimensions mentioned in Sect. 1.1. This pluralistic characterization allows for identification of central and "fringe" stakeholders alike, which may lead to valuable discussions in the team of whose sake the change is carried out for and who eventually gets impacted.

A basic tenet of the method is that each identified stakeholder (or "actor") may have multiple, sometimes conflicting, relationships to the proposed change; this means that motivations and possible conflicts may be identified not only between but also within different stakeholders. For example, the same person who is the *subject* of the problem behind the change, may also be a *blocker* in the sense of not wanting the situation to change (e.g. because it is perceived as a threat to other existing benefits of the current state). The person who is appointed *change owner* may simultaneously be the *solution builder*.

Table 1 The eight stakeholder "roles" or categories that make up the Change Agent Infrastructure (CHAI) framework for identifying crucial stakeholders. The "problem" referred to is the trigger of the proposed change project

Role	Definition/typical actions	Examples
Initiators	Bring attention to the problem and place it on the official agenda to be dealt with	Manager, Engineer, Safety representative
Sponsors	Not directly affected or active in the project, but support keeping the problem on the agenda	Retired board member, Workplace inspector, Interest organization
Subjects	Actors whose operations are directly affected by the problem and/or the outcomes of the change project	Operators, Maintenance personnel, Subcontractors
Documenters	Document the problem, requirements, quality demands/criteria, decisions and the solution's design and implementation	Manager, Engineer, External controller
Convincers	Convince decision-makers that there is a need for action, using measurements, statistics and quantification	Engineer, Occupational health service, Ergonomist
Change owners	Are given the legitimate ownership of the problem, the mission to solve it, and the mandate to determine when it has been solved	Production Manager, Engineer, Operators
Solution builders	Are made responsible for examining, advising and eventually solving the problem, either in part or fully	Engineer, Operator, Ergonomist, Expert, Solution team
Blockers	Use arguments, power and/or withholding of access, resources or contacts needed to proceed with the change that addresses the problem.	Managers, Operators, Economics department, Union

2.3 Workshop Materials and Procedure

Generally, it is recommended to run a CHAI workshop as a moderator-led physical event using a large visual template (Fig. 1) on a tabletop or on a wall, sticky notes and pens, and having participants sitting around the template where they have equal access to the materials and template space; that said, the method has been run in variants, e.g. as a digital workshop where participants entered their input using smartphones. The role of the moderator is to clarify the purpose and procedure of the method, encourage input by prompting participants to think about different roles, and to aid the final summation and documentation steps.

To proceed with using CHAI in a workshop format, the following steps are recommended:

(1) Handing out of materials, e.g. sticky notes and pens for the participants.
(2) Familiarization of the participants with the 8 roles, including a walk-through of each role's typical actions in relation to a change, and some examples.

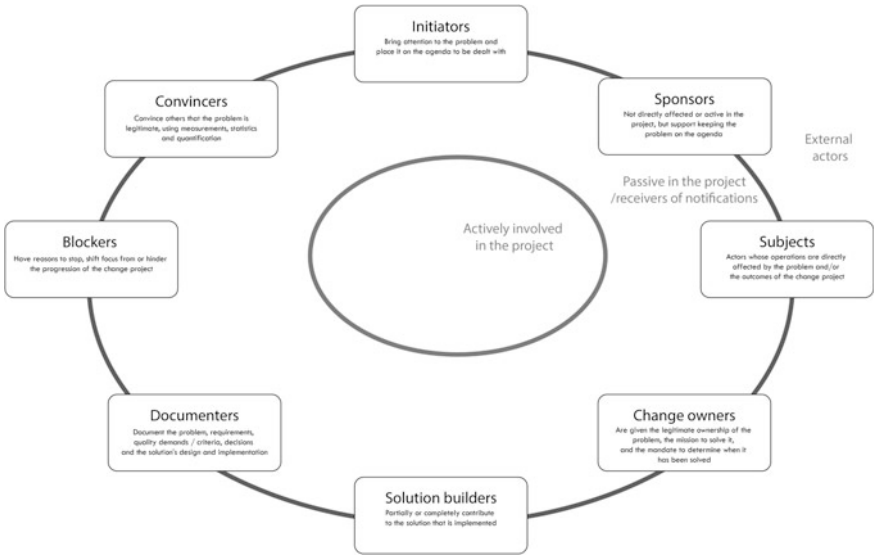


Fig. 1 The workshop template layout used in participative workshops to allow participants to classify particular actors as being Internal (inside the rings) or External (outside the outer ring) in relation to the change project; here the template is shown with an additional distinction of internal actors within the organization being actively or passively involved. Variants of this template have been drawn manually on whiteboards in some workshops, depending on space requirements and number of participants

(3) Agreeing within the group on a rule for determining whether identified actors are defined as *internal* or *external* to the change project at hand. This determines where actors are physically placed in the space inside or outside the area demarcated by a line. Typically, *internal* means that actors are within the boundaries of a clearly defined organization (such as a company, a project group etc.) or scope of influence.
(4) Once participants are ready, everyone suggests possible actors that belong to any of the 8 roles. These are written down on sticky notes together with all the different roles they occupy, and placed closest to their "main" role, and also on the appropriate side of the boundary separating *internal* and *external* actors.
(5) Lines are drawn between the sticky notes and all the roles that an actor plays. It is essential to keep clear *how many* lines enter into each role field, as these will be counted later.
(6) When the group is satisfied that all relevant actors that have been identified, two calculations are made: the number of *roles per actor (r =)* is counted for each individual actor, and the number of *actors per role (a =)* is also counted. (For example, a "Floor manager" who is identified as being both Change owner and Blocker has r = 2, while the role of "Solution builder" has a = 4 if the problem-solving is contributed to by an Engineer, an External consultant, an Experienced operator, and a Line technician).
(7) Finally, the group discusses their insights regarding which actors play (or should play) influential parts. Particularly, the moderator should help the group explore the consequences if any role is found to have very few or very many actors (a = low or high values), *or* if any actor has too many different roles, lacks a role that they should have, or simply has a role that is inappropriate for the change process.
(8) Summation of which stakeholder relations are the most interesting for the group to address, and deciding on the format for documentation and dissemination of the results.

It is important to emphasize that the picture that emerges of who the important stakeholders are, based on the CHAI method, *is entirely based on the perceptions of the participants in the workshop.* Although it is certainly a worthwhile exercise even for a smaller group or a single person to use the framework to imagine and map the range of roles and actors that are relevant to a project, the limitation remains the same as for most SA methods: the basis of knowledge of "how things are" rests entirely on the variety of perspectives brought by participants. For this reason, the authors emphasize that although the origin of the method is as an "individual thinking tool" for ergonomics change agents [12], the real power of CHAI lies in using it as a participative method to unify the multiple perceptions and increase the knowledge in a change project team.

3 Use Case: CHAI in a Manufacturing Layout Change Workshop

The CHAI method has been iteratively developed and tested in a number of cases in research and education that have gradually contributed to the elaboration and simplification of the method. Here, as an example, the use of the method is reported in the case of a workshop in an applied research project called 3D-SILVER, a research project with academic and industrial partners jointly developing a software for production layout and workplace assessments. The type of change processes addressed within the scope of the research project is the redesign process of production systems in two manufacturing companies, to adapt them for changed demands or requirements. The CHAI method was used in two iterations to identify the stakeholders involved in change processes of production layouts, and to determine who are primary users and secondary users of the software.

In the first iteration, the academic researchers assembled and ran a CHAI workshop to identify internally which stakeholders seemed important (based on observations from two on-site project meetings with the two main industrial partners). The first workshop generated a long-list of stakeholders, as well as consensus among the research team about which stakeholders seemed a bit ambiguous in their criticality; it was agreed that their roles should be clarified in a similar exercise involving the other project partners.

The second CHAI workshop was held during an internal project meeting of 3D-SILVER, with representatives from two companies and a software developer. The main author moderated the workshop and the workshop participants were the academic partners and company representatives. The possible stakeholders that had been previously identified were presented at the beginning of the workshop as pre-made sticky notes. The participants were tasked to identify additional stakeholders, and to consolidate or remove duplicated and non-relevant stakeholders. The sticky notes of the remaining stakeholders were placed in the designated areas of *actively involved* in the project, *passive* in the project, and *external* to the project. Lines were drawn to the roles according to the method description and number of actors and roles calculated respectively. The result from the workshop was documented and summarized by the workshop moderator. A short report summarizing the result was sent out to the participants, including a guide for interpreting the implications of some roles having many or few/no actors, as well as certain actors having too many, too few, or inappropriate roles (Fig. 2).

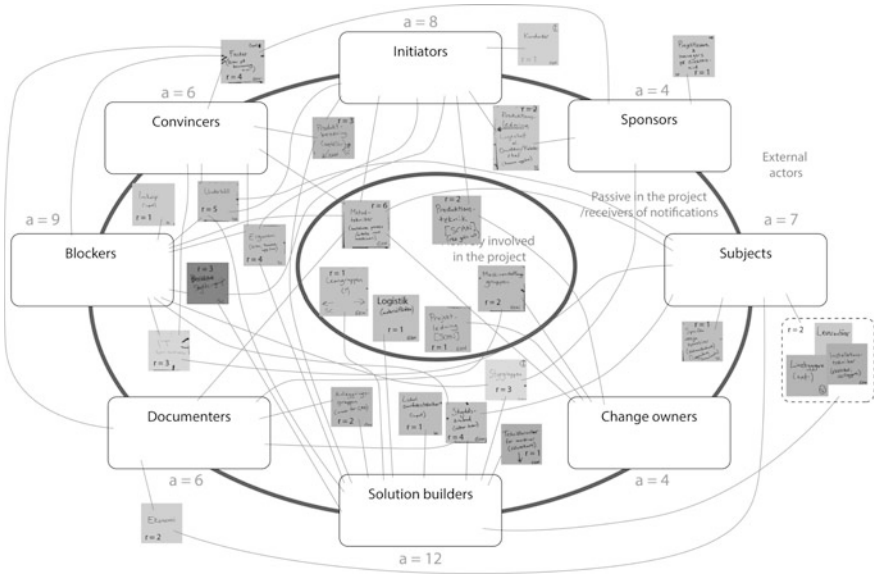


Fig. 2 The CHAI workshop template with identified stakeholders (on sticky notes) sorted into active/passive internal and external to the project, and tallies for number of actors (a=) per role, and number of roles (r=) per identified actor. The workshop enabled participants to identify crucial project actors who could be aided by development of specific functions in the software being developed in the 3D-SILVER project

4 Discussion

Due to the broad scope of complex areas that many change projects entail, it is not feasible for one person to master all of the aspects involved. A common solution is to engage and involve subject matter experts from the affected fields in a participative design process. As mentioned earlier, this has many benefits; it can facilitate buy-in from future users of the manufacturing system, and the range and quality of the input to the design process is likely to improve. Involving cross-functional actors promotes a more holistic design approach and reduces the risk of sub-optimizing certain aspects [13]. This suggests again that the deliberate involvement of appropriate stakeholders is key to enabling success in change projects, although it should be mentioned that the need to involve stakeholders may change across the different stages of a design process [14]. The CHAI method currently does not prescribe a particular stage to be implemented in, but has mainly been tested in early planning stages of projects, as is conventional for many SA methods.

CHAI aims to help a change project team avoid pitfalls like inappropriately distributing responsibility for, monopolizing or overlooking a particular critical role in carrying out a change project. Mapping this early in a change project can be extremely valuable, particularly as a participative workshop activity geared at

facilitating a common understanding in the change project team of which stakeholders' motivations may end up acting as facilitators or roadblocks to the change. Identifying (1) stakeholders that have a multitude of roles, (2) are the sole "actor" playing and dominating one particular role, or (3) a role that is not fulfilled by any stakeholder, offers a novel and more prescriptive way of identifying critical stakeholders.

By way of being one of few examples in literature of prescriptive frameworks where "roles" are used to help identify stakeholders, Dul et al. [14] also specify categories of stakeholders of system design: these are *System actors, System experts, System decision makers* and *System influencers,* and the authors go on to specify within each group the four levels of individual, company, country/region, and world (indirect) stakeholders. The higher levels of this hierarchy are said to be able to "represent" stakeholders at lower levels. They also stated that people could belong to more than one stakeholder group depending on their role. The CHAI method goes even further in the direction of being prescriptive. This is intentional, but because of the higher degree of specification of the 8 roles, it is important to remember that its underpinning theory [2, 3, 10, 11, 15, p. 383] has been developed specifically in a HF/E setting, which may limit the transferability of these stakeholder categories to other domains. The possibility of using these "roles" in other settings is being tested as part of the method's ongoing development, but at this stage, their relevance is based on there being a workplace change intention at the root of a project.

When used in the empirical example, the CHAI method enabled input from several people from different organizations in a rather short time and enabled a ranking of the most important stakeholders for the research project. The range of identified stakeholders is also intended for use at later stages of the software development, to recruit suitable end users (stakeholders identified as critical workplace change agents) for evaluation of the project outcomes, e.g. usability testing of the software. A challenge found with the method during this specific use case was to combine stakeholders from the two industrial partners, mainly due to their use of different internal terms for similar stakeholders (who had similar but slightly varied work tasks). This needs to be handled by the moderator, but is likely to arise only in workshops where several organizations must unify their terminology.

5 Conclusions

A novel and participative SA method specifically targeting HF/E-related workplace change projects has been described and elaborated. Its novelty includes identifying potential stakeholders through a framework of distinct categories/roles that have been found in previous research to facilitate or hinder the proposed change. Mapping the "decision dilemmas" that stakeholders may face, as well as identifying

over- or underrepresented roles, may benefit the change project in terms of determining information needs and how the project team should be staffed. The CHAI analysis is visual, participative and helps to clarify the various participants' understanding of the change at hand and what it means for them—this contributes positively to information strategies and decisions that facilitates the planning and execution of a sustainable change.

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References

1. Carayon, P., Smith, M.J.: Work organization and ergonomics. Appl. Ergonon. **31**, 649–662 (2000)
2. Broberg, O., Hermund, I.: The OHS consultant as a 'political reflective navigator' in technological change processes. Int. J. Ind. Ergon. **33**, 315–326 (2004)
3. Theberge, N., Neumann, W.P.: Doing 'organizational work': expanding the conception of professional practice in ergonomics. Appl. Ergon. **42**, 76–84 (2010)
4. Reed, M.S., Graves, A., Dandy, N., Posthumus, H., Hubacek, K., Morris, J., Prell, C., Quinn, C.H., Stringer, L.C.: Who's in and why? A typology of stakeholder analysis methods for natural resource management. J. Environ. Manage. **90**, 1933–1949 (2009)
5. Mitchell, R.K., Agle, B.R., Wood, D.J.: Toward a theory of stakeholder identification and salience: defining the principle of who and what really counts. Acad. Manag. Rev. **22**, 853–886 (1997)
6. Savage, G.T., Nix, T.W., Whitehead, C.J., Blair, J.D.: Strategies for assessing and managing organizational stakeholders. Executive **5**, 61–75 (1991)
7. Cameron, B.G., Seher, T., Crawley, E.F.: Goals for space exploration based on stakeholder value network considerations. Acta Astronaut. **68**, 2088–2097 (2011)
8. Koch, J., Michels, N., Reinhart, G.: Context model design for a process-oriented manufacturing change management. Procedia CIRP **41**, 33–38 (2016)
9. Smith, M.J., Sainfort, P.C.: A balance theory of job design for stress reduction. Int. J. Ind. Ergon. **4**, 67–79 (1989)
10. Berlin, C., Neumann, W.P., Theberge, N., Örtengren, R.: Avenues of entry: how industrial engineers and ergonomists access and influence human factors and ergonomics issues. Eur. J. Ind. Eng. **8**, 325–348 (2014)
11. Berlin, C.: Human factors experiences in context-comparing four industrial cases using a soft systems framework. Ergon. Open J. **4**, 131–144 (2011)
12. Berlin, C.: Ergonomics infrastructure—an organizational roadmap to improved production ergonomics. Chalmers University of Technology (2011)
13. Lu, S.-Y., ElMaraghy, W., Schuh, G., Wilhelm, R.: A scientific foundation of collaborative engineering. CIRP Ann.-Manuf. Technol. **56**, 605–634 (2007)

14. Song, X.M., Thieme, R.J., Xie, J.: The impact of cross-functional joint involvement across product development stages: an exploratory study. J. Prod. Innov. Manage. **15**, 289–303 (1998)
15. Dul, J., Bruder, R., Buckle, P., Carayon, P., Falzon, P., Marras, W.S., Wilson, J.R., van der Doelen, B.: A strategy for human factors/ergonomics: developing the discipline and profession. Ergonomics **55**, 377–395 (2012)

Improvement of Productivity and Employee Performance Through an Efficient Human Resource Management Practices

Lerato Ngwenya and Clinton Aigbavboa

Abstract The role of employees within organisations are very vital in the management and survival of any organisation; this is because their performance is influenced by a set of human resource management (HRM) practices. Similarly, the process of attracting, developing, and maintaining a talented and energetic workforce to support the organisational goals and objectives is the ultimate aim of HRM. Therefore, the aim of this study is to investigate the improvement of construction workers productivity through an efficient Human Resource Management practices. Hence, this research identified the HRM practices and comprehensively evaluated the impact of these practices on productivity and employee performance. The data used in this paper was derived from both primary and secondary sources. Twenty-eight structured questionnaires were distributed to the HR department of a construction company that was used for the study. A return rate of 100 % was achieved since the respondents were purposively selected. The data received were analysed using the Statistical Package for the Social Science (SPSS). The result of the analysis showed certain HRM practices enhances productivity and employee performance in a construction company. Therefore, it is highly recommended that HRM practices are effectively implemented to enhance productivity and employee performance. Thus, obtaining and sustaining competitive advantage. Moreover, the study observed that happy and satisfied employees have higher performance, therefore making it easy for management to motivate them thus attaining the firm targets. The study contributes to the body of knowledge on the improvement of construction workers productivity through an efficient Human Resource Management practices.

Keywords Human resource management · Human resource management practices · Productivity · Employee performance

L. Ngwenya (✉) · C. Aigbavboa
Department of Construction Management and Quantity Surveying, University of Johanessburg, Johanessburg, South Africa
e-mail: leengwenya@gmail.com

C. Aigbavboa
e-mail: caigbavboa@uj.ac.za

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1 Introduction

The construction industry is a labour intensive sector and a stimuli for emerging economies [1]. To maintain competitive advantage, firms must continually improve their performance by reducing costs, be innovative in conceiving, designing and executing organisational objectives, improving quality, and productivity [2–4]. Therefore, effective human resource management (HRM) has become crucial and critical to the realisation of individual, organisational, community, national and international goals, and objectives. Byars and Rue [5] define HRM as successful management of employees in an organisation to achieve organisational goals through a strategic system of activities. However, the management of employees is a challenging task opposed to the management of capital or managing technology, [6]. Past studies have acknowledged that there is positive relationship between HRM practices and employee performance and organisational performance [7–11]. Hence, the importance of effectively implementing HRM practices. HRM practices may be described as activities directed at managing the poor human resource and ensures that resources are employees towards the fulfilment of organizational goals [12]. Agreeably, Schuler and Jackson, [13], defined HRM practices as a system that attracts, develops, motivates, and retains employees to ensure the effective implementation and the survival of the organisation and its members.

Therefore, the aim of this paper is to investigate the improvement of productivity and employee performance through an efficient human resource management. Hence, this research identified the HRM practices and comprehensively evaluated the impact of these practices on productivity and employee performance.

2 Human Resource Management

2.1 Human Resource Management Practices

Armstrong [14] described Human Resource Management (HRM) as a strategic and logical approach to the management of an organisation's most valued assets, which are the employees. The employees collectively contribute to the achievement of organisational objectives. Similarly, Johanson [15] noted that HRM is a function within an organisation designed to maximize employee performance in service of the companies' strategic objectives. Furthermore, Collings and Wood [16] highlighted that HRM is concerned with how people are managed within organisations, focusing on policies and systems. Agreeably, Delery and Doty [17], conceptualises HRM as a set of policies and practices adopted and implemented to ensure that a firm's human capital contributes to the achievement of its business objectives. HRM is governed by HRM practices, such as employee recruitment, training, and development (T&D), performance appraisal, and compensation and benefits [18]. Furthermore, HRM is deals with industrial relations, which is, the balancing of

organisational practices with regulations arising from labour laws [19]. Schuler and Jackson [13] defined HRM practices as a system that attracts, develops, motivates, and retains employees to ensure the effective implementation and the survival of the organisation and its members. Similarly, HRM practices may be viewed as a set of practices used by the organisation to manage human resources through facilitating the development of competencies that are firm-specific, produce complex social relation and generate organisation knowledge to sustain competitive advantage [20]. Though there may be different definitions on HRM and its practices, they all relate to specific practices, and organisational policies that are designed to attract, develop, motivate, and retain employees who ensure the effective functioning and survival of the company.

2.2 Human Resource Management Practices on Productivity and Employee Performance

The main objective of any organisation is to make a profit and to achieve this organisational goals. Hence, adequate HRM planning and development programs should be implemented in order enhance performance [21–23]. Human Resource Management is an essential component for an organization regarding labour turnover, productivity as well as the financial growth of an organisation. Similarly, HRM plays a pivotal role in employee's retention and their productivity, [12]. There are numerous factors that influence this aspect, like inadequate wages, salaries or allied benefits, poor reward system and lack of H&S facilities. [24, 25]. According to Mansour [26] and Jahanian et al. [27] employees get frustrated due to an imbalance in the work and personal life and fail to render optimum performance. In addition, it was observed that job stress and unfair treatment by the HRM department or manager demotivates even the talented employees [9]. Organizations that do not evolve and implement human resource development (HRD) often experience HRM related issues, which result in employees not acquiring professional development through training, mentoring or coaching. Hence, employees encounter issues like; boredom or lack of challenge in the work environment [28, 29].

Previous literature on HRM indicates that HRM practices contribute to sustaining competitive advantage for the corporation [30–33]. Kinicki and Kreitner [34] observed that happy and satisfied employees have higher performance, therefore making it easy for management to motivate them thus attaining the firm targets. Likewise, the recognition of significant training practices enables management to create a conducive working environment, which ultimately improves the motivational levels as well as the performance of its workforce. Huselid [30] noted that the effectiveness of HRM would transfer on the behaviour of the workers as a result of human resource management. Hence, Carlson et al. [35] suggested five HRM practices that enhance performance that are; T&D, performance appraisals,

compensation, benefits, and employee motivation and recruitment package. Also, the study by Teseema and Soeters [10] which was conducted on eight HRM practices revealed that recruitment and selection practices, placement practices, training, compensation, employee performance evaluation, promotion, grievance procedure and pension or social security have an effect on employee performance. Based on existing literature it may be concluded that, if certain HRM practices are not effectively implemented by the organisation then employee performance would be stagnant or decline. Therefore, it is imperative that a firm adopt and effectively implements HRM practices that will increase its employee's performance [36].

However, Guest [37] in his study demonstrated that the Impact of HRM on performance depends upon the response of worker towards HRM practices, hence, the impact of HRM will move in the direction of the employee perception. The research by Armstrong [38] noted that employee performance is normally looked at regarding outcomes. However, it can also be seen on an employee behavioural perspective. Thus, confirming the definition; "performance does not include the results of an employee's behaviour, but only the behaviours themselves" [39]. Meaning that it is not based on what employees produce or the outcomes of their work but on the employees' behaviour. Further, Ghebregiorgis and Karstan [40] said that the perception of the employees provides a broad evaluation of the company's HRM functions and practices such as recruitment and selection, T&D and compensation and benefits. Hence, Huselid [30] argued that the impact of HRM on the behaviour of the employees results in the effectiveness of the employees.

A recent study by Elnaga and Imran [36] classified performance into five elements namely: planning, monitoring, developing, rating, and rewarding. In the planning stage, Planning means setting goals, developing strategies, and outlining tasks and schedules to accomplish the goals. Planning entails setting goals, developing strategies, and outlining tasks and schedules to accomplish the goals. Monitoring is the phase whereby employees are continually checked to see how well they are doing to meet the set goals and providing constant feedback to employees and work groups on their progress toward reaching their goals. Also, monitoring assists in changing unrealistic or problematic standards. The developing stage helps employees improve on any poor performance seen throughout the duration one has been working in the company. The rating gives an overview of the employee performance; this is helpful when organisations are comparing performance over time or among its employees. During the rewarding stage, it is imperative that employers know their best performers are therefore rewarding them accordingly.

3 Research Methodology

The study adopted a two-step approach for research data collection (primary and secondary data). The secondary data were collected through the review of the literature, from published and unpublished articles, journals, and textbooks. Whilst the

primary data were collected using a structured questionnaire, whereby the field findings provided a general view and in-depth knowledge of the study's objective. The questionnaire was selected because it enabled the researcher to be consistent in asking questions and data yielded were easy to analyse statistically. Twenty-eight copies of the developed questionnaire which was part of an existing research instrument, were distributed to the HRM department of a Grade 9 (CIDB grading) South African construction company. Instructions and guidelines of how the respondents should answer the questionnaires were stipulated on the questionnaires. All distributed questionnaires were received back. Thus, rendering a 100 % response rate. Based on the research approach and design of this study, purposive sampling, which is a non-probability sampling technique was most favourable the study. This sampling technique proofed to reduce biases by ensuring that the participants are selected based on the specific research study and not by convenience, locality, or other considerations.

3.1 Mean Item Score (MIS)

A five-point Likert scale was used to determine the HRM practices, the impact of human resource practices on turnover, productivity, and corporate performance and employee motivation in a South African construction company on the identified factors from the reviewed literature. The adopted scales were as follows:

1. = Strongly disagree
2. = Disagree
3. = Neutral
4. = Agree
5. = Strongly agree

The five-point scale was transformed to mean item score for each of the factors of causes and effects of cost overruns as assessed by the respondents. The indices were then used to determine the rank of each item. The ranking made it possible to cross compare the relative importance of the items as perceived by the respondents. This method was used to analyse the data collected from the questionnaires survey. The mean item score was calculated for each item as follows;

$$\text{MIS} = \frac{\mathbf{1n_1 + 2n_2 + 3n_3 + 4n_4 + 5n_5}}{\sum \boldsymbol{N}} \tag{1}$$

where
n1 Number of respondents for factor number 1;
n2 Number of respondents for factor number 2;
n3 Number of respondents for factor number 3;
n4 Number of respondents for factor number 4;
n5 Number of respondents for factor number 5;
N Total number of respondents

After mathematical computations, the factors were then ranked in descending order of their mean item score (from the highest to the lowest).

4 Findings/Discussions

Findings from the data analysis revealed that out of the 26 respondents, 66.61 % were female, and 33.33 % were male. The majority of the respondents were Africans at 56.6 %, followed by the Whites at 40.7 % and the coloureds proofed to be the minority at 3.7 %. Findings relating to the respondents' age group revealed 22.2 % of the respondents were in the age group 41–45 years old, 18.5 % were in the age group 36–40 years old, 14.8 % of the respondents were above 51–55 years old, 14.8 % of the respondents were between 56 years and above, 11.1 % of the respondents were in the age group 26–30 years old, 7.4 % were in the age group 31–35 years old, 7.4 % were in the age group 46–50 years old, and 3.7 % of the respondents were in the age group of 20–25 years old. When asked the question pertaining to the respondents work experience it revealed that 29.6 % had more than 20 years' experience, 22.2 % had experience that ranged from 6 to 10 years, 18.5 % had experience in the range of 11–15 years, 14.8 % had experience that ranged between 16 and 20 years, and 14.8 % had experience that ranged from 1 to 5 years in human resource management (HRM). Further, 14.8 % of the respondents had bachelor's degrees, 37.0 % of the respondents only had matric (grade 12) certificates, 37.0 % had diplomas, 7.4 % of the respondents had a certificate in Human Resource, and 3.7 % of the respondents had master's degrees.

4.1 HRM Practices on Productivity and Employee Performance

For the purpose of the data collection, HRM practices were separated into: "performance and productivity factors", "Human resource factors," and "Organisational factors" respectively. However, these factors are considered contributors to the enhancement of productivity and employee performance in a construction company.

Results from the data analyses revealed that performance and productivity (P&P) factors such as high morale employees, P&P increase due to the job knowledge, P&P increase due to enhanced competency of employees, High morale employees give better performance, P&P increase due to positive attitude of employees, and P&P increase due to the ability of the employees. The data revealed that human

Table 1 HRM practices: performance and productivity practices

Performance and productivity practices	MIS	SD	R
High morale employees are more productive	4.22	1.15	1
Job knowledge	4.19	0.92	2
Enhanced competency of employees	4.11	0.89	3
High morale employees give better performance	4.11	1.22	3
Positive attitude of employees	4.07	0.83	4

resource factors are; equity of compensation and benefits, challenging Employment Structures and opportunities, Provision of effective training, career development, fair and equitable performance Management, and challenging employment opportunities. Furthermore, the organisational factors are; company policies and culture, Communication and consultation, satisfactory working environment, organisational loyalty and pride, and effective integration of working relationships.

The respondents were asked to rank the impact of human resource practices on performance and productivity. High morale employees are more productive was ranked first (MIS = 4.22; SD = 1.15); P&P increase due to the job knowledge was ranked second (MIS = 4.19; SD = 0.92); P&P increase due to enhanced competency of employees was ranked third (MIS = 4.11; SD = 0.89); High morale employees give better performance was also ranked third (MIS = 4.11; SD = 1.22). Similarly, P&P increase due to positive attitude of employees was ranked fourth (MIS = 4.07; SD = 0.83) (Table 1).

The respondents were asked to rank the impact of human resource factors on the productivity and employee performance. Equity of compensation and benefits ranked first (MIS = 3.48; SD = 1.16); Challenging Employment Structures and Opportunities ranked second (MIS = 3.41; SD = 0.97); Provision of effective training ranked third (MIS = 3.37; SD = 1.01); Career Development ranked fourth (MIS = 3.33; SD = 1.11); Fair and equitable Performance Management ranked fifth (MIS = 3.26; SD = 1.13) (Table 2).

The respondents view on organisational factors. Company policies and culture was ranked first (MIS = 3.70; SD = 0.95); Communication and consultation were ranked second (MIS = 3.56; SD = 1.19); and the satisfactory working environment was ranked second as well (MIS = 3.56; SD = 1.09). Further, the table reveals organisational loyalty and pride was ranked third (MIS = 3.41; SD = 1.22); and effective dispute resolution was ranked third (MIS = 3.41; SD = 1.25); Effective

Table 2 HRM practices: human resource factors

Human resource factors	MIS	SD	R
Equity of compensation and benefits	3.48	1.16	1
Challenging employment structures and opportunities	3.41	0.97	2
Provision of effective training	3.37	1.01	3
Career development	3.33	1.11	4
Fair and equitable Performance management	3.26	1.13	5

Table 3 HRM practices: organisational factors

Organisational factors	MIS	SD	R
Company policies and culture	3.70	0.95	1
Communication and consultation	3.56	1.19	2
Satisfactory working environment	3.56	1.09	2
Organisational loyalty and pride	3.41	1.22	3
Effective dispute resolution	3.41	1.25	3

Mean item score (MIS); Standard deviation (SD); Rank (R)

integration of working relationships was ranked fourth (MIS = 3.30; SD = 1.03) (Table 3).

The results from the data analysis align with the study by Mansour [26] and Jahanian et al. [27] who noted that employees get frustrated due to an imbalance in the work and their personal life and fail to render optimum performance. In addition, it was observed that job stress and unfair treatment by the HRM department or manager demotivates even talented employees. Organizations that do not evolve and implement certain HRM practices often experience HRM related issues, which result in employees not acquiring professional development through training, mentoring or coaching. Hence, employees encounter issues like; boredom or lack of challenge in the work environment [28, 29]. Similarly HR practices like selection and training effects the performance of the employee. Moreover, the quality and quantity of performance is associated with clear and measurable goals; and incentives in most organisation. Likewise, Kinicki and Kreitner [34] observed that happy and satisfied employees have higher performance, therefore making it easy for management to motivate them thus attaining the firm targets. Therefore, the recognition of significant training practices enables management to create a conducive working environment, which ultimately improves the motivational, levels as well as the performance of its workforce. Additionally, the adoption of HRM planning, T&D, compensation, and benefits, HRIS, recruitment, and selection produces higher levels of productivity than the more traditional approaches that involve rigid job definitions, hourly pay, and stringent work rules. Furthermore, Ghebregiorgis and Karstan [40] said that the perception of the employees provides a broad evaluation of the company's HRM functions. Thus, the argument by Huselid [30] that the impact of HRM on the behaviour of the employees results in the effectiveness of the employees.

5 Conclusion and Recommendations

Human resource management plays an important role in increasing productivity and employee performance through the effective use of the companies' most valuable asset, its employees. Findings from the study was supported by work from previous researchers and scholars. Hence, it is important that HRM practices are effectively

implemented in order to enhance productivity and employee performance. Thus, obtaining and sustaining competitive advantage.

The survey focused the attention on the improvement of productivity and employee performance through an effective human resource. The data was collected through research questionnaire. The data that was collected and was analysed using a computer software, SPSS. This study identified HRM practices and their effect on productivity and employee performance and comprehensively evaluated the impact of these practices on productivity and employee performance as compiled from an extensive literature review.

The study revealed the importance of effectively implementing HRM practices in order to enhance productivity and employee performance. Thus, obtaining and sustaining competitive advantage. Additionally, the study observed that happy and satisfied employees have a higher performance, therefore making it easy for management to motivate them. Moreover, findings from the study was supported by work from previous researchers and scholars. The findings suggest that performance and productivity (P&P) factors are High morale employees are more productive, P&P increase due to the job knowledge, P&P increase due to enhanced competency of employees, High morale employees give better performance, P&P increase due to positive attitude of employees, and P&P increase due to the ability of the employees. The data revealed that human resource factors are; equity of compensation and benefits, challenging Employment Structures and opportunities, Provision of effective training, career development, fair and equitable performance Management, and challenging employment opportunities. Furthermore, the organisational factors are; company policies and culture, Communication and consultation, satisfactory working environment, organisational loyalty and pride, and effective integration of working relationships.

Therefore, it is recommended that the firms' goals and objective be effectively communicated to all employees; recognition of significant training and development and compensation and benefits practices which are fair and equitable enables management to create a conducive working environment, which ultimately improves the motivational levels as well as the performance of its workforce. Likewise, challenging employment structures and work opportunities.

References

1. Loosemore, M., Dainty, A., Lingard, H.: Human Resource Management in Construction Projects: Strategic and Operation Approaches. Spon Press (2003)
2. Garavan, T.N., Bamicle, B., O'Sulleabhain, F.: Management development: contemporary trends, issues and strategies. J. Eur. Ind. Training **23**(4/5), 3–12 (1999)
3. Hodgetts, R.M., Luthans, F., Slocum, J.W.: Strategy & IHRM initiatives for the 00s environment: redefining roles & boundaries, linking competencies & resources. Organ. Dyn. **28**(2), 7–21 (1999)
4. Losey, M.R.: Mastering the competencies of HR management. Hum. Res. Manag. **38**(2), 99–111 (1999)

5. Byars, L., Rue, L.: Human resource management. In: Byars, L., Rue, L. (eds.) Human Resource Management, 8th edn, pp. 19–37. McGraw-Hill/Irwin, New York (2006)
6. Pirzada, D.S., Hayat, F., Ikram, A.A., Ayub, M., Waheed, K.: Impact of human resources management practices on turnover, productivity and corporate financial performance. Eur. J. Bus. Manag. **5**(10), 163 (2013)
7. Gould-Williams, J.: The importance of HR practices and workplace trust in achieving superior performance: a study of public sector organizations. Int. J. Hum. Res. Manag. **14**(1), 28–54 (2003)
8. Park, H.J., Mitsuhashi, H., Fey, C.F., Bjorkman, I.: The effect of human resource management practices on Japanese MNC subsidiary performance: a practical mediating model. Int. J. Hum. Res. Manag. **14**(8), 1391–1406 (2003)
9. Wright, P.M., Garden, T.M., Moynihan, L.M.: The impact of HR practices on the performance of business units. Hum. Res. Manag. J. **13**(3), 21–36 (2003)
10. Tessema, M., Soeters, J.: Challenges and prospects of HRM in developing countries: testing the HRM-performance link in Eritrean civil service. Int. J. Hum. Res. Manag. **17**(1), 86–105 (2006)
11. Qureshi, T.M., Akbar, A., Khan, M.A., Sheikh, R.A., Hijazi, S.T.: Do human resource management practices have an impact on financial performance of banks? Afr. J. Bus. Manag. **4**(7), 1281–1288 (2010)
12. Siebers, P.O., Aickelin, U., Battisti, G., Celia, H., Clegg, C., Fu, X., Peixoto, A.: Enhancing Productivity: The Role of Management Practices. The University of Nottingham, Nottingham (2008)
13. Schuler, R.S., Jackson, S.E.: Linking competitive strategies with human resource management practices. Acad. Manag. Executive **1**(3), 207–219 (1987)
14. Armstrong, M.: Handbook of Human Resource Management Practice, 11th edn. Kogan Page, London (2009)
15. Johnason, P.: HRM in changing organizational contexts. In: Collings, D.G., Wood, G. (eds.) Human Resource Management: A Critical Approach, pp. 19–37. Routledge, London (2009)
16. Collings, D.G., Wood, G.: Human resource management: a critical approach. In: Collings, D. G., Wood, G. (eds.) Human Resource Management: A Critical Approach, pp. 1–16. Routledge, London (2009)
17. Delery, J.E., Doty, D.H.: Modes of theorizing in strategic human resource management: tests of universalistic, contingency, and configurational performance predictions. Acad. Manag. J. **39**(4), 802–883 (1996)
18. Paauwe, J., Boon, C.: Strategic HRM: a critical review. In: Collings, D.G., Wood, G. (eds.) Human Resource Management: A Critical Approach, pp. 38–54. Routledge, London (2009)
19. Klerck, G.: Industrial relations and human resource management. In: Collings, D.G., Wood, G. (eds.) Human Resource Management: A Critical Approach, pp. 238–259. Routledge, London (2009)
20. Minbaeva, Dana B.: HRM practices and MNC knowledge transfer. Pers. Rev. **34**(1), 125–144 (2005)
21. Barney, J.: Firm resources and sustained competitive advantage. J. Manag. **17**, 99–120 (1991)
22. Jackson, S.E., Schuler, R.S.: Managing Human Resources: A Partnership Perspective, 7th edn. South-Western College Publishing (Thomson Learning), Cincinnati, OH (2000)
23. Pfeffer, J.: Competitive Advantage through People: Unleashing the Power of the Work Force. Harvard Business School Press, Boston (1994)
24. Caliskan E.N.: The impact of strategic human resource management on organization reference. J. Naval Sci. Eng. **6**(2), 100–116 (2010)
25. Long, C.S., et al.: The impact of human resource management practices on employees turnover intention: a conceptual model. Interdisc. J. Contemp. Res. Bus. **4**(2), 629 (2012)
26. Mansour, M.: HR Practices Impact on Firm Performance: An Empirical Study. King Fahd University of Petroleum and Minerals, management and Marketing Department (2011)
27. Jahanian, A., et al.: human resource management and productivity: a comparative study among banks in Bahawalpur division. Eur. J. Bus. Manag. **4**(8), 253 (2012)

28. Boohene, R., et al.: The effect of human resource management practices on corporate performance: a study of graphic communication group limited. Int. Bus. Res. **4**(1), 266 (2011)
29. Patel, S.C., et al.: Human resource management practices: a comprehensive review. Pak. Bus. Rev. (2012)
30. Huselid, M.: The impact of human resource management practices on turnover, productivity, and corporate finance performance. Acad. Manag. J. **38**(3), 635–670 (1995)
31. Arthur, J.: Effects of human resource systems on manufacturing performance and turnover. Acad. Manag. J. **37**, 670–687 (1994)
32. Terpstra, D.E., Rozell, E.J.: The relationship of staffing practices to organizational level measures of performance. Pers. Psychol. **46**, 27–48 (1993)
33. Gerhart, B., Milkovich, G.T.: Employee compensation: research and practice. In: Dunette, M. D., Hough, L.M. (eds.) Handbook of Industrial and Organizational Psychology, vol. 3, pp. 481–569. Consulting Psychologists Press, Palo Alto, CA (1992)
34. Kinicki, A., Kreitner, R.: Organisational Behaviour. McGraw-Hill, New York (2007)
35. MacDuffie, J.: Human resource bundles and manufacturing performance: organisational logic and flexible production systems in the world auto industry. Ind. Labour Relat. Rev. **48**, 197–221 (1995)
36. Elnaga, A., Imran, A.: The effect of training on employee performance. Eur. J. Bus. Manag. **4** (5), 137–147 (2013)
37. Guest, D.: Human resource management, corporate performance and employee wellbeing: building the worker into HRM. J. Ind. Relat. **44**(3), 335–358 (2002)
38. Armstrong, M.: A Handbook of Human Resource Management Practice, 7th edn. Kogan Page, London (2000)
39. Aguinis H.: Performance Management, 2nd edn. Person Education, Inc., publishing as Prentice Hall (2009)
40. Ghebregiorgis, F., Karsten, L.: Human resource management practices in Eritrea: challenges and prospect. Empl. Relat. **28**(2), 144–163 (2006)

Organizational Communication: Discussion of Pyramid Model Application in Shift Records

Edmara dos Santso Drigo and Salvador Ávila Filho

Abstract This work aims to discuss the flow of internal communication through a pyramid model of organizational communication. The first part is a reflection on the "ideal" model of organizational communication and its flow represented in the figure of the pyramid. The operator's speech in the operational process helps decision-making in the managerial sphere. The second part of this work is a reflection on highly subjective factors that may affect this speech. Finally, there is an analysis of the operators' records in the shift book of a Water Treatment Plant (WTP), located in northeastern Brazil, with a view to suggest procedures for implementing the communication pyramid model in the organization. The work is mostly qualitative method and provides quantitative data on the communication implement. The results suggest the need for improvement in the events shift book format of and trainment for operators and leaders.

Keyword Human factors · Operator discourse · Organizational communication

1 Introduction

Improving the anticipation of problems or controlling impacts are determining factors for the organizations' management. Organizational communication is a powerful strategic tool for this and other purposes. Therefore, it is necessary that the institution rethink their communicational tools and skills periodically. The discussion about communication complexity within the institution is in the current scenario, due to relational chains that pass in the workplace.

E. dos Santso Drigo (✉) · S.Á. Filho
Polytechnic, Federal University of Bahia, Professor Aristides Novis. 2, Federação, Salvador, Bahia, Brazil
e-mail: edmarasd@gmail.com

S.Á. Filho
e-mail: avilasalva@gmail.com

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Researchers of organizational communication area and organizational studies already understand linguistics as a possibility of administration. Carrieri et al. [1] states that, although not a new technique, discourse analysis begins to be included in organizational discussions and researches, in Brazil, in the late 1990. The discourse analysis contribution in the organizations has generated positive discussions on this approach to organizational studies. Saraiva et al. [2] states that both the speech and the organization are "fruits of human ingenuity" linked to a context, so aspects of the human dimension need to be analyzed in the search for understanding certain behaviors, attitudes and omissions. Historical and linguistic aspects will be part of the discursive process; in this scenario, the senses and meanings will be built.

Cornelsen et al. [3] says that the qualitative gain is significant when the theoretical tools of discourse analysis are used in investigations in the field of organizational studies. According to the author, the language is deeply linked to the organization; it is a "constitutive element" of the organization reality. Particular phenomena can be seen through the written records.

In this perspective of complexity that make up the organizational environment, this paper proposes a reflection on the "ideal" flow of organizational communication in the pyramid format. After that, we discuss about subjective factors that can affect the operator's speech and interrupt or affect the flow of communication in this pyramid. Such factors are multidisciplinary, based on the Critical Discourse Analysis, in theories of Social Sciences and Anthropology of Organizations. The second part of this work, you will find a shift book analysis of a water treatment plant located in northeastern Brazil, reliable data should be provided by operators in their communication tool, as this information will build the history of the plant. Considering the importance of communication of shift abnormalities, so that procedures and strategies can be rethought and management decisions can be taken, the operations manager must validate the operator's discourse, in order to have communication follow its flow. This work aims at the written speech of the operator.

2 Pyramid Model of Organizational Communication

The hierarchical division in organizations consists of three levels: strategic, tactical and operational. At strategic level, decisions on the management system are made. In the tactical level, you can find management decisions, working out as a link between the top and the operation. At the operational level, you find the workers who perform the tasks and execute strategically planned and tactically managed procedures. This description enables mentally visualizing the figure of the pyramid with its tracks. The discussion in this session is about the flow of communication in the pyramid, acting strategically to achieve the proposed goals. When what is planned finds it difficult to run or the final product quality is compromised, communication should serve as a tool to help the management system. It must flow through the tactical level, where the operations manager must validate the operator's speech, then go up to strategic level so that abnormalities can be checked and strategies and procedures

can be rethought, starting a new cycle and a new management system. Then it will be necessary to think of the flow of communication. The flow, according Schermerhorn et al. [4], can be upward, downward and side stream.

a. Vertical downward flow—the strategic level; the top of the pyramid communicates the lower levels of management decisions, procedures, policies, changes in the organization, feedbacks. According to Lelis [5] "*the information from the top to the base helps to minimize the spread of rumors and creates a sense of security and involvement among the receptors*." This sense of security can be a motivational variable, recognizing and reinforcing behaviors and encouraging better performance. Another motivating factor is the fact of being informed about what happens in the organization.
b. Vertical upward flow—when data from the base help build new strategies for the organization. It is feedback time to superiors about employees. In this flow, problems, questions, suggestions, and relationship with the organization are reported.
c. Side stream—It happens at the same level; communication, in this case, is more informal than formal. According to Ribeiro [6] while the information flow is facilitated in this level, some conflicts may build barriers. This flow is also called horizontal and of great interest for this work, that intends to analyze the communication between operators in different shifts of a water treatment plant and its channel.

   The concept later complemented with cross flow or diagonal and circular.
d. Diagonal flow—This flow is also known as cross-sectional or longitudinal, transiting units and Ribeiro organizational levels [6].
e. Circular flow—It transits all levels cyclically. It is an important concept of flow of communication in the organization for this organizational communication pyramid proposal.

The model of the Organizational Communication Pyramid (see Fig. 1), proposed in this paper, allows information to transit the hierarchical levels in cyclical movements top-down and bottom-up in order to define intervention techniques in the company seeking operational control.

This model will be studied from the Internal Organizational Communication (IOC), External Organizational Communication (EOC), and Cognitive Communications (CGC), which can be considered as individual internal. To analyze the model of the organizational pyramid, an operational industrial plant is considered to have already worked for at least five years with enough history to review the strategies and management systems originally adopted.

The operator's speech (OS), which is in the base of the organizational communication pyramid, offers hypotheses of events that result from the interaction with the statistical interpretation of the process and alarm variables, indicating the paths to operational control. In return, the speech becomes the control process based on speech (OSC—operator's speech control).

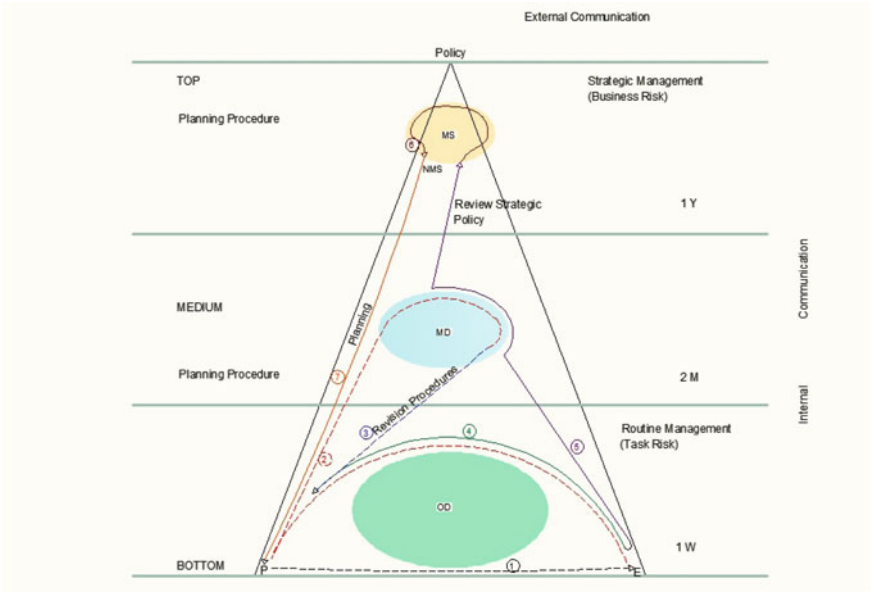


Fig. 1 Pyramid of organizational communication. *Source* Autors

Climbing the organizational communication pyramid, this control is incorporated into the management level, when the manager accepts the hypothesis already validated and speaks to his team in the form of management guidelines, thus, the Manager's Speech (MS) is aligned to the operator's speech. The actions of standardization resulting from the management guidelines, build criteria for the standardization of procedures, here named as resulting control of the manager's speech (CMS).

This standardization already accepted by the operating team turns to be incorporated into the routine by performing the procedures, here named as standard. Acceptance is a process of interpretation, requirements, analysis, corrections to reaching the agreement that this is the best way to perform critical operations. The movement between bottom-medium/medium-down strengthens the technical culture and increases the chance of operational excellence, but depends on the complementary resultant of the communication cycle in the organizational pyramid. When maturing managerial guidelines, there is the return of common manners, rules and behaviors, not previously seen by strategic area that need to transform policies, adapting the old view of shareholders with a blend of technical contribution culture. So, the bottom-medium-up movement is complete and returns enriched, holding the external benchmark of corporate visions in organizational areas plus the contribution, offered by the operator's Speech (OS vs. OSC), Manager's Speech (MS vs. CMS) and standards corporate policies.

The internal climate needs to be in accord with the external demands. The organization that does not meet the needs of people will not remain in the market. The external

public expects a clear and ethical message from the organization. Shareholders, community, other brands, customers, government and non-governmental organizations, media, suppliers, dealers and distributors, form this external public.

In the age of information and the speed it reaches all parts of the network society, such tools are required for a competitive organization. Society is interested in the company's image that engages in social, noble causes and cultural projects. It is necessary to satisfy not only the physical needs of stakeholders in the product. The strategic discourse for external communication needs to be coordinated by a specialist in connection with the public. The internal discourse should collaborate to meet external demands, flowing in the three pyramid levels in order to anticipate and prevent risks to the task and business. Risks in the task, accidents or incidents are risks to the business.

2.1 Cognitive Communication

Cognition is the process of acquiring knowledge, cognitive and emotional universe in the context of the organization will directly affect the ways of thinking and acting of the man at work. Cognitive communication then is the ability to communicate by activating the perception, setting priorities, activating memory, seeking what is causing anomalies, including the environment in view of the complexity and exercising emotional balance. Language and cognition are linked intrinsically. Cognitive processes are structured and organized by language. Van Dijk [7, 8] draws attention to another perspective on speech-society relationship: Cognitive Discourse Analysis as a new line of Discourse Critical Analysis. Based on Speech-Cognition-Society triad, a perspective where cognitive analysis complements social analysis.

Then, the cognition constitutes the interaction through shared knowledge, even socially constructed, is individually practiced as from the speech and writing. Van Dijk [8] calls attention to the fact that one cannot understand cognitive aspects without understanding that knowledge and beliefs are acquired and passed on discursively in the social contexts. The socio-cognitive view, as stated Falconi, covers cultural and social factors to understand the cognitive process that takes place in society and not just individually. Cognitive discourse analysis, according to the author, studies the collective and individual action in the (re)construction of knowledge, ideologies, beliefs and attitudes. Learning should generate change in attitude. This analysis is interested in understanding the socio-cognitive operations involving text, as the various ways to report an event and the questioning regarding how we can understand something that is not in the text. The man in the workplace activates his cognitive map, his knowledge on the process, the equipment, the physical and chemical reactions, and his memory. The mental map activated for

routine management will be present in the operator's speech incorporating his subjectivity. As we discussed earlier in this paper, Van Dijk [9] claims that mental models, building the mind map are "*cognitive representation of our experiences*", are experiences that whenever related to culture, historical, political, social aspects, personal experiences, beliefs and ideologies will make up what we are. In this plan, individual differences, group patterns of perception and decision live together.

Mental map failure, deficiency in language resources, judgement and conflicts of interest can significantly compromise the operation and communication in the organization. At the base of the pyramid, the lateral or horizontal flow of operators' communication between shifts, socio-cognitive elaborations of written or spoken speech will influence the reliability of the data of the procedures performance, the routine management, possible anomalies, search for causes, building hypotheses and decision-making. These data, based on individual and group processes, will be interpreted by the next round shift, which will produce sense according to the individual and collective mental map in this shift (interlocutor) to keep the performance of procedures and record at the end of their shift.

2.2 Organizational Communication Pyramid—Cycles Relations and Periods

In the "ideal" plan of the communication cycle and in order that the communication flows in a circular way, first we must consider objective aspects and those highly subjective discursive production. Mental filters are components of judgments about the relevance of information that can block the channel, discouraging the operator as "discursive actor" by the lack of feedback and measures regarding what has been reported. The CMS from their mental models, will validate the received information from the shift so that it can follow its flow. The same process will be in the strategic area, including political and economic factors and the organization's interest to change or not the management system. The communication of new procedures should be reported, discussed and its understanding should be checked. The communication cycle in the pyramid model requires coordinated strategies and leadership style based on dialogic relationship with listening skills, understand relational contexts and share knowledge. It requires strategies that assume a flexible attitude towards the real need of review procedures, review of strategies and redesigns. The chronological cycle involves complexity for fixation. It may be determined in the communication strategy of the organization or by any unexpected event. It is important that the operating manager checks the records every week and meet the operators to discuss the plant status. In case there are no urgent or emerging events, every other month, the manager can discuss the operating plant status with the strategic sphere and go over suggestions, complaints and employee's contributions. It is recommended that companies review their strategies and procedures from the obtained results every year.

3 What Can Be Behind Operator's Speech?

The operator's speech in his workplace can be constructed, shaped and filtered by some concepts that will be discussed in this work: mental models Senge [10], Van Dijk [9], context models (Van Dijk 2013), education level and language, theory of representation Goffman [11], generational conflicts and concept of critical analysis of Fairclough Modulation speech [12].

a. Mental models—To Van Dijk [9], "*cognitive representation of our experiences may not be significantly connected to our episodic memory*", they are dynamic, made up of personal elements that make them unique, not only the production but also the interpretations. There might be misunderstandings during the interaction moment. According to the same author, what makes sense for the speaker, may not make sense (or make sense in part) to the person receiving the information, "the speaker and the receptor can have overlapping models, but they are different, in other words, the same speech can be interpreted in different ways." The operator's language is a filter of mental models; we externalize what is in our consciousness, or, even more complex, we externalize what is below our level of consciousness. Such models make those involved able to adapt their speech or their interpretations to the situation, according to their purposes every moment of interaction.
b. Context models—Van Dijk [9] states that the context is no longer a situation and it is a mental model susceptible of interpretation and subjectivity liabilities. Even presenting objective component, the context is the result of collective construction made by individual and unique actors. It controls both the process of discursive construction and its interpretation. They are dynamic mental models resulting from experiences. They are practices embedded in social and historical situations that varies from culture to culture.
c. Education level and language—Different levels of education and language can directly affect the written speech of the operator as well as his understanding in reading manuals and procedures. Engineer-operator language styles can lead to disruption in communication and, therefore, human error. The intelligibility imbalance, according to Dejours [13], causes an imbalance in social relations. According to Boyer [14], engineers and designers do not share the same "cognitive tool" nor the same operators' language level, operating in the so-called "factory floor", enabling gaps in communication. This language barrier can hamper what the author calls "mutual understanding" between actors. Operation and engineers are separated in action domains. In domain 1, engineers had symbolic terms, technical engineering language, "*legitimated knowledge epistemologically by the laws of the exact sciences, formal knowledge to understand and act on the production process.*" With other words, the technical language of the area. Operators are in domain 2, their language reflects an implicit knowledge, very rich, cunning language, "they do not enjoy objectification, formalization… essential language to control the process," knowledge often not recognized.

d. Representation Theory—Goffman's work [11] "*The presentation of self in everyday life*" covers a relevant theme for this discussion by studying the social life within the physical boundaries of a building or a factory. In Social Sciences area, the text is discussed in Organizational Anthropology subject. It reflects on behavior from the perspective of theatrical performance. The way the individual presents and builds an image believed to be appropriate to that situation and place. When the message is formally written and transmitted, it acts to give the impression of interest, the behavior is molded, and to the author, the communication is manipulated. Goffman says there is an "operational agreement" where it is appropriate to avoid open conflict; it deals with the issue of expressiveness, a concern for giving an impression.
   To prevent the first impression is discredited, the individual makes use of protective practices or defense, and these are techniques to ensure printing. The author says that without this defense, no impression survive.
   Since the coexistence in the workplace is a reality that cannot be escaped, the scenario assumes collective character. The representation will continue fueling the situation, which may compromise communication in the organization. The communication of events will suffer interference of the group's interests, some facts can be emphasized and others decreased.
   The theory of representation is an important theoretical basis for discourse analysis in organizations. It supports to understanding relationships, attitudes and omissions. It is also important foundation to the discussion on organizational climate and leadership training.
e. Generational Conflicts—Ladeira et al. [15] writes that the generation gap is related to preferences and worldviews, the most productive employee is the most motivated one, which is why the organization needs to better meet their human resources and the variables that motivate them. Generations differ from one another, according to Zemke [16], for their beliefs, values and priorities. The priorities are conflicting when it coexists in Baby Boomers (born post war), Generation X (1962–1977) and Generation Y (from 1978) work environment. There are positive issues in this coexistence, such as different perspectives and integration. A generation has a lot to learn and teach each other. However, there are many imbalances due to conflicts arising from ways of thinking and relating to the institution. Each political, social and cultural historical moment will shape the behaviors and ways of interpreting the world. The challenge of the organization is dealing with heterogeneous groups. Models for Generation X will not fit for the Y, and the conflict will exist if a previous generation covers behavior and ways of thinking similar to its younger generation, with other perspectives.
f. Modulation—According to Fairclough [12], speech consists of 3 main ways: Acting modes—interacting in social events, question social relations; Representing modes—representation of aspects of the physical, mental, social worlds and texts and Being modes—construction of identities in discourse. The construction of identity in language and society is related to power relations, reproduction and social change.

The author cites Halliday's work, on the concept of "modality" with regard to "speaker's judgment about the probabilities or obligation involved in the case." The process involves two poles: positive and negative, available to the speaker's choice. In the exchange of information, the significance of this polarity is to affirm or deny anything. Fairclough [12] defines "modulation" as how much you commit when you ask, say, demand or offer.

The objective mode is when the speaker designs his point of view as universal or acts as a channel for another person or the group's point of view. While the subjective mode reveals the speaker's affinity or preference. The author says that "as much as you commit is a significant part of what you are." This commitment to what is said, acts as a filter based on previously worked judgments on what to say and what not to say, on the implications of your story.

4 Necessary Proceedings for Pyramid Model Application of Organizational Communication

For the application of organizational communication pyramid model at the Water Treatment Plant, a data collection on the shift book was made for reflection on the reliability of this instrument. Ten pieces of information were established as essential in the shift register. The absence of this information can generate material losses and uncompromising the water quality, representing great risk to public health. Records of 150 shifts were analyzed in the period from February to April 2015.

According to the analysis of Tables 1 and 2, the shift book with open format that consists of narrative genre, does not offer reliable data due to lack of important information for operational control. You can see in Table 1 that in the 150 shifts, no record presents all 10 pieces of information considered essential and in Table 2, you

Table 1 Records in the shift book WTP—essential information—Feb–Apr 2015 shift records amount to information

Essential information in the shift book 150 shifts—February, March and April	Number of shift records with the information
1. R1 level	0
2. Chemicals consumption and stock	62
3. Chemicals adjustments	15
4. Residual chlorine—water quality	24
5. Filters control and cleaning	6
6. Level voltage or current of departure time of bomb R5	0
7. Conditions of supply system	32
8. System stops	25
9. Reservoir level	60
10. Water supply	123

Table 2 Number of essential information in shift records—Feb–Apr 2014

Number of information contained in the registration shift 150 shifts—February, March and April	% of sample
Record with only 1 of 10 essential information	27.3
Record with 2 of 10 essential information	29.3
Record with 3 of 10 essential information	34
Record with 4 of 10 essential information	8
Record with 5 of 10 essential information	1.3

can see that the greatest amount of information found is 3 of 10 that should be included in the shift book.

Table 1 shows the number of times the information considered essential appear in this period while Table 2 shows the amount of information per shift register.

Other considerations that we can mention on the analysis in the shift book are:

a. Feedback Absence—The book has no feedbacks in 40 % of reported abnormalities.
b. Unevenness of instruction and language—We can observe great disparity in the number of information and in the details, comparing each operator's records. The operator 01, who has a higher level of education takes a leading position in the written speech, he details the routine events with a wealth of observations, passes on procedures and guidelines coming from the management of operations and maintenance.
c. Nothing to declare—Even in the case of a critical period in the WTP, due to months of drought and water coming up with greater amount of impurity, 33 % of shift registers repeat a pattern of response "*I pass the shift just as it was passed to me*." The incidence of this response pattern is not observed in the registry of operator 01 mentioned in the above topic.
d. Organizational Climate—The operator's text, even with technical and abbreviated language, reflects some conflicts from the perspective of discourse analysis. Assessments with respect to the work of another operator can be found, record contestations written in the book and explicit disagreement of decisions taken by operational management. Actions taken by the operator are always justified with "by order of" someone, which can suggest defense activation. Evaluative statements of approval are also explicit, as well as grammatical semantic relations of cause and reason.

The necessary procedures for implementation of the organizational communication pyramid model for the WTP, according to the shift book analysis would be:

a. Rethinking the Shift Book Format—failure in communication on the shift book is worrying, the omission of data that could be valuable for the recognition of danger signs. The open book format, unstructured, can provide resistance to the

operator to report, describing any abnormalities; the narrative genre depends on each one's language resources. Each operator has different levels of language and education. It can collaborate with the omission of information. A semi-structured communication system through a checklist to monitor the stages of production can help in the rescue of routine abnormalities at the time of reporting.

b. Considering Cognitive factors, subjective in Training—To detect and later register abnormalities, it is necessary that the operator has training and knowledge of processes, equipment and chemical-physical reactions. The operator's training must go beyond the objective and utilitarian purpose; discussions are possible in training sessions, workshops, subjective group dynamics, motivational factors that stimulate the individual commitment with the institution. It is necessary to feel important part of the organization, be aware of the need to report facts of operational routine without fear of sanctions, punishments or judgments.
c. Training leaders—Leadership of the future should value the discourse of seeking knowledge on the concepts discussed in Sect. 3 of this work. The organizational climate affects communication and results. The leader needs to think about mental models, judgments that can interrupt the flow of communication, conflicts arising from age group and different level of education, the context of discursive production, the power struggles that permeate organizations. Concepts of Linguistics and Anthropology of Organizations among others can join the field of Engineering and Administration in these trainings, as they bring relevant discussions for both: the operating level and the managerial and strategic levels.

5 Conclusion

This work is limited to discuss the communication among operators in base of the pyramid. The flow of communication should move in the organization so that the information coming from the base of the pyramid, the operational level, collaborates on the business level to discuss with the strategic level about the management system. Procedures that need to be reviewed can be flagged through the operator's speech. However, in this case, we saw that the communication system operators use between shifts to register the operational routine in the WTP is flawed and can compromise the display of the operating plant status. Omissions of information verified in the shift book may hide failures that, in the future, may represent material loss, and in this case, great risk to public health and damage to the organization's image. The procedures for implementing the organizational communication pyramid model in the WTP would enable the operator's awareness of the importance of reporting events and seeing a new perspective for management, bringing change in the organizational culture.

References

1. Carrieri, A.P., Silva, A.R.L., Souza, M.M.P., Pimentel, T.D.: Contribuições da análise do discurso para os estudos organizacionais. Economia e Gestão. 6(2006)
2. Saraiva, L.A.S.: Estudos organizacionais e análise do discurso: Aproximações possíveis. In: Carrieri, A.P, Saraiva, L.A.S, Pimentel, T.D., Souza-Ricardo, P.A.G.: Análise do discurso em estudos organizacionais. Juruá (2009)
3. Cornelsen, E.L.: Análise do Discurso no Âmbito dos Estudos Organizacionais: uma abordagem teórica. In: Carrieri, A.P., Saraiva, L.A.S., Pimentel, T.D., Souza-Ricardo, P.A.G.: Análise do discurso em estudos organizacionais. Juruá (2009)
4. Schermerhorn, J.R., Hunt, J.G., Osborn, R.N.: Fundamentos de Comportamento Organizacional, 2nd edn. Bookman, Porto Alegre (1999)
5. Lélis, E.C.: A influência da comunicação informal num sistema de informação. In: XIII Simpósio de Engenharia de Produção. Unesp, Bauru (2006)
6. Ribeiro, S.X.: Gestão da Estratégia da Comunicação na Pequena Empresa: Um Estudo Comparativo de Casos de Empresas Hoteleiras da Região Central do estado de São Paulo. Dissertação de Mestrado, EESC-USP, São Paulo (2008)
7. Van Dijk, T.: Discourse, context and cognition. Discourse Stud. **8**, 159–177 (2006)
8. Van Dijk, T.: El Discurso como Interacción en la Sociedad. In: Van Dijk, T. El Discurso como Interacción Social. Gedisa Editorial,Barcelona (2000)
9. Van Dijk, T.: Discurso e Contexto: Uma abordagem sociocognitiva. Contexto, São Paulo (2012)
10. Senge, P.: The Fifth Discipline. Doubleday, New York (1990)
11. Goffman, E.: A representação do Eu na Vida Cotidiana. Vozes, Petrópolis (1985)
12. Fairclough, N.: Discurso e Mudança Social. Editora UNB, Brasília (2001)
13. Dejours, C.O.: Fator Humano. FGVSP (2007)
14. Bouyer, G.C.: The language as a cognitive instrument in the work of operator of the continuous process production. Produção Online. **11**, 779–802 (2011)
15. Ladeira, L.B., Costa, D.V.F., Costa, M.P.C.: O Conflito de Gerações e o Impacto no Ambiente de Trabalho. In: IV Congresso Nacional de Excelência em Gestão, pp. 1–19. Ceneg, Rio de Janeiro (2012)
16. Zemke, R.O.: Respeito às Gerações. Modernas práticas na gestão de pessoas. Elsevier, Rio de Janeiro (2008)

Human Factors for Development of Corporate Internal Social Investments Portfolio

Aleksandr Kozlov and Anna Teslya

Abstract The chapter discusses the problem of the formation of social investment in Russia. Obstacles to the development of social investment are considered. The problem of the influence of the human factor on the social activity of companies is analyzed. The research identification of the reaction of the internal stakeholders of a corporation in carrying out the social activity of the company enables the main factors that guide the corporation during the implementation of social investment projects to be identified. Recommendations are formed for corporations to enhance social activity.

Keyword Human factors · Social investment · Stakeholders · Corporate community · Involvement · Social effect

1 Introduction

Further development of the social investment process in Russia is impossible without top managers understanding the interrelation between social investment and the results of the companies' financial and business activity. The main obstacles are the ambiguity in the interpretation of the term "social investment", the difficulties in assessing the economic effect of social investment and its deferred character. Another problem is the need to consider the human factors in the social activity of the company.

Social investment is defined as an investment in the social sphere "in order to increase the quality of life by creating new technologies and mechanisms of fund allocation among different social groups in accordance with their needs" [1]. A positive social effect is one of the important characteristics of social investment.

A. Kozlov (✉) · A. Teslya
Peter the Great St. Petersburg Polytechnic University,
St. Petersburg, Russia
e-mail: avk55-spb@yandex.ru

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We define social investment as material, technological, managerial, financial and other resources aimed at the implementation of social programmes, developed according to the interests of the major internal and external stakeholders. As a result of this implementation, the company is supposed to get both a social and economic effect in a strategic outlook. The economic effect that the company gets is likely to be deferred and hard to estimate. In the same way, we distinguish between the concept of social investment and philanthropy.

Corporate decisions based on ethical values and aimed at meeting the requirements and expectations of the stakeholders are regarded as necessary (European approach) or legally unnecessary (American approach).

Shareholders, investors, the company's staff, and government agencies are the most important stakeholders. The local community and non-profit organizations are less influential and important stakeholders. Two kinds of social investments are defined: internal (investment in staff training, health care and safety of labour) and external (fair business policy towards consumers and business partners, environmental activity and efficient use of resources, and investments in the development of local communities).

The different structure of the company's social investments will be formed depending on the degree of influence and importance of the various stakeholder groups.

Thus the goal of the investigation is to identify the perceptions of Russian companies' employees concerning the social investments of their companies. In the long run, social investments are shaped with a view to developing the human factor of the company itself or the local community.

2 Existing Literature

Analysing existing literature we can see that the number of researches devoted to the problems of social investments is growing. Donaldson and Dunfee [2] analysed social investments in the framework of business ethics. Halsa [3], in paying attention to the role of the public as an important stakeholder, investigated the social risks in the strategic management of corporations. The author emphasizes that "Cultures and communities are not homogenous and perceptions can change without warning" [4] in regard to social investment in the framework of the corporate social responsibility concept. Corporate social responsibility, according to Leisinger, can be understood as the socio-economic product of the organizational division of labour in a complex modern society. Global poverty and poor health conditions are in the main the responsibilities of the world's national governments and international governmental organizations, which possess society's mandate and appropriate organizational capabilities [4]. Heath [5] expresses doubts concerning the idea that "the stakeholder paradigm represents the best framework for articulating the logic and structure of these obligations". There are two alternative approaches to the study of business ethics. The first one is business ethics as

professional ethics and the second is the market failure approach. These approaches help to bridge the waiting of stakeholders and public reaction.

The public reaction to companies' social activity isn't always clear and evident, and isn't predictable. The results of polls conducted show that the reaction of consumers depends mostly on the way they perceive the company's activity, not on the activity itself [6]. Among the factors that lead to positive feedback are the consistency between the direction of social investment and the company's mission, and the time for the consumer feedback to become apparent.

Not every social project provides positive feedback on the performance of the company as it is shown in [7]. For example, US consumers consider the company's socially responsible behaviour in deciding whether to purchase a product, but they would buy another company's products if the prices were lower [8]. Thus, the human factor is very important, and its effect must be considered.

Social investment in Russia is still in the stage of formation and development. From the '90s up until the beginning of the '00s companies appropriated funds mostly for single charitable projects due to the peculiarities of Russian legislation, which allowed taxes not to be paid if the sum was less than 3 %. Since 2000 social investment has become more systematic. The first non-financial environmental report was presented by OJSC Ryasanskaya GRES in 2000. OJSC Gazprom began producing reports in 2001. In 2012, 69 companies published their reports. A total of 160 Russian companies and 635 reports were registered in the national register of non-financial reports from 2000 to 2016 [9]. Table 1 shows the growing interest of Russian companies in social investment, in spite of the crisis in the economy.

The number of Russian companies producing regular reports has been growing bit by bit since 2000. The quality of information reported has increased as well. The number of reports' as plural concept that present information about the company's triune total, including economic, environmental and social components, is also growing.

The largest number of non-financial environmental reports are submitted by energy companies, oil and gas companies, and companies operating in the field of finance and insurance.

Table 1 National Register of Non-financial Reports

Indicators	May 2014	February 2016	Growth (%)
1. Total number of companies	134	160	119
2. All non-financial environmental reports, including	472	635	135
3. Environmental reports (ER)	41	52	127
4. Social reports (SR)	219	269	123
5. Sustainable development reports (SDR)	150	204	136
6. Integrated reports (IR)	42	87	207
7. Industry reports (InR)	20	23	115

Since 2008, due to the economic crisis, the majority of Russian companies have ceased to consider social investment as only a tool for interacting with the government and it has become an element of companies' strategy as confirmed by corporate reports. Russian business is at the stage of transition from the image support of vulnerable groups to the implementation of social projects at the junction of internal and external companies' social policy, social investment and investments in the development of human capital assets.

Despite the increase in the social activity of companies, in Russia there is a low level of public recognition of companies' activities. More than 70 % of Russian companies carry out charitable activities, but a survey of more than 55 % of citizens demonstrated that they did not know about such organizations [10]. The economic effect of the realization of the projects is usually complex to quantify and delayed. One of the most important conditions for obtaining economic benefits, as confirmed by studies, is a positive response in favour of both external and internal stakeholders in the social activity of the corporation.

3 Methodology

Social investment in Russia is still in the stage of formation and development. Our research identification of the reaction of the internal stakeholders of a corporation in carrying out the social activity of the company enables the main factors that guide the corporation during the implementation of social investment projects to be identified.

The objective was to identify the main factors that should be considered in the implementation of corporate social investment projects and the development of the company's strategy.

The purpose of the study was to seek respondents' views on the following issues:

How does the staff refers to social investments within the company and to other companies implementing social investment?

How social investments affect the stakeholders?

What do respondents think about the company's social activity?

Is the social activity mandatory?

Which are the areas of social activity of companies? What areas of social activity are preferable according to the respondents?

What are the purposes of implementing social projects? Why are social projects beneficial to the company?

When there is an economic crisis, is the company obliged to continue the implementation of social projects or not?

The survey involved employees of various companies; their positions were different.

Employees of trading companies comprised 29 % of respondents, employees of industrial companies 12 %, and service professionals 47 %.

There are 25 points in the developed questionnaire. Some questions have only one answer; some questions have multiple answers (for example, the consequences of the implementation of social projects for the company).

4 Findings

The majority of respondents (47 %) felt that their company provides social investment, or plans to implement it (11 %). Eleven percent of respondents said that the company does not adhere to the concept of corporate social responsibility and has no plans. Twenty-nine percent of respondents were not aware of the social activity of the company.

Nevertheless, the majority of respondents were not able to give examples of socially responsible companies. Only 17 % of respondents named the large companies (Gazprom, Coca-Cola, Norilsk Nickel). None of the respondents named our company. Most respondents believed that companies should engage in social investment such as willingness (82 %). Twelve percent of respondents considered social activity to be mandatory for the company. Six percent of respondents believed that social investment is the duty of the state.

The results of the impact of the social activity of the company on different groups of stakeholders are given in Table 2. Note that although, in the opinion of the respondents, only 70 % of employees increase their loyalty to the company, 100 % of respondents said that their personal relationship with the company improves. Ninety-four percent of respondents support the social activity of companies.

Russian companies are characterized by independent choice and the realization of social investment projects (47 %). Twenty-three percent of companies prefer to work with local government agencies. Twelve percent of companies interact with individuals or other companies. Only 6 % of companies cooperate with non-profit organizations.

The majority of Russian companies (52 %) use for social investment monetary funds. Twenty-three percent of companies use the company's resources (premises, equipment, vehicles), or provide information or business relations.

Table 2 The ratio of concernment of stakeholders to the company's social investments

How the relationship with the company implements social projects				
	Increases	Not changed	Decreases	I dont know
Staff	70 %	18 %	–	12 %
Business partners and government agencies	71 %	23 %	–	6 %
Local community	76 %	17 %	6 %	–
Your relationship	100 %	–	–	–

All respondents shared the concept of "charity and social investment". Among the reasons for the implementation of a company's social investment projects (recipient noted items 1–3) were: desire for economic benefits (53 %); growth of shareholder loyalty, suppliers and lenders in order to ensure the stability of the company's development (47 %); ensuring the loyalty of the local community and government agencies (47 %); increasing the loyalty of employees (40 %); moral motivation and altruism (29 %); enforcement by government agencies (23 %).

In the opinion of respondents, the implementation of social projects affects (or is able to influence): the company's growing reputation and image in the local community (53 %); the occurrence of new partners and new opportunities (47 %); the increase in the loyalty of employees (35 %); the increase in the stability of the company (23 %); the improvement of competitiveness (23 %); the improvement of relations with government agencies (23 %); the improvement of the financial performance of the company (18 %); the strengthening of relationships with clients (18 %); and the improvement of the political position of the company (12 %). Companies do not use social investment for the testing of new technologies or product development.

At the same time, only 18 % of respondents said that their company evaluates the financial impact of social investments.

Only 18 % of respondents indicated that their company expects the financial results of social investment projects. Twenty-three percent of respondents believe that the calculation is not necessary, as the social projects have non-commercial purposes, while 6 % of respondents answered that it is impossible to evaluate the financial performance of projects. Other respondents could not answer the question. Consequently, the concept of charity and social investment is not shared by the majority of respondents.

This statement is confirmed by indirect answers to the following questions. Among the groups, which are predominantly aimed mainly at the implementation of the company's social projects, are noted: company staff (53 %), disadvantaged (disabled, pensioners) (29 %); consumers (24 %); and local community (6 %). If decisions were made directly in relation to the respondents, the following social investment projects were adopted: assistance to disabled persons (35 %); organization of the leisure of young people (23 %); environmental projects and infrastructure development (17 %); and orphanages (6 %). Forty-one percent of respondents believed that all projects should be aimed at supporting the company's employees.

In the current difficult economic situation, 60 % of companies expect to reduce income. In the opinion of respondents, companies should: continue the social projects but don't start new projects (47 %); reduce (11 %) or suspend (6 %) investments; abandon social investments (18 %).

Now we formulate the results and recommendations for companies.

We noted the growing interest in social investment in Russian society. But the Russian public has little information about the social activity of companies. This is a negative factor. The demand growth for business involvement in the solution of local communities' problems is gradually forming. Investing in staff development is

very attractive for Russian companies. Since the majority of the respondents invest in personnel, employee loyalty to the company is increased.

One important factor that prevents the development of social investment is the lack of understanding of the consequences of a social investment impact on the mechanism of company value increase, which is typical for Russian managers. Not all companies evaluate and take into account the financial impact of social investments. The concept of charity and social investment is mixed. Insufficient understanding of the necessity of social investment realization and the mechanism of its impact on the financial performance of a company may lead to a conflict of interest between main stakeholders because of the diversity of their interests.

Russian companies interact poorly with non-profit organizations and funds. They are characterized by independent choice and the realization of social investment projects, while in Europe and the USA non-profit organizations are active partners of the social sphere and have a considerable influence on the tendencies and forms of corporate social programmes. Non-transparent activity and the lack of competent specialists in this sphere are among the reasons that prevent Russian companies from working with non-profit organizations.

In terms of the inactivity of non-profit organizations, activation of interaction with governmental institutions, in particular, may become a condition that will make social investment attractive for companies.

5 Conclusions

The impact of social investment on a company is ambiguous. This means that there is a need for a careful and cautious approach to decision-making in considering the project realization of social investment. The following factors that can provide a positive economic impact from social investment should be noted: the forming of a long-term strategy for social investment and its acceptance along with the company's main development strategy; the forming of positive feedback on social investment programme realization from stakeholders.

Russian business is in the stage of transition from the image support of vulnerable groups to the implementation of social projects, internal and external companies' social policy, social investment and investments in the development of human capital assets.

6 Limitations and Further Investigations

The chapter presents the results of the first stage of investigation. The sample of the correspondent group is not sufficiently representative to draw generalized conclusions. Further research needs to cover other industries and receive more information for generalizations to be made. One interesting idea for further research is to

investigate the differences between the opinion of top managers and the perceptions of employees. This would help to prove hypothesis concerning the gap between the illusions of superiors and reality.

References

1. Soboleva, I.P.: Socialnaya politika kak factor ustoichivogo razvitiya. Economist **3**, 65–73 (2003)
2. Donaldson, T., Dunfee, T.E.: Ties That Bind: A Social Contracts Approach to Business Ethics. Harvard Business School Press, Boston (1999)
3. Halsa, A.S.: Social risk management cheat sheet: management strategies for the oil and gas industry. In: SPE Latin American and Caribbean Health/Safety/Environment/Social Responsibility Conference 2013: Sustainable Solutions for Challenging HSSE Environments in Latin America and the Caribbean, pp. 198–203 (2013)
4. Leisinger, K.M.: The corporate social responsibility of the pharmaceutical industry: idealism without illusion and realism without resignation. J Bus. Ethics Q. **15**(4), 577–594 (2005)
5. Heath, J.: Business ethics without stakeholders. J. Bus. Ethics Q. **16**(4), 533–537 (2006)
6. Becker-Olsen, K.L., Andrew, B.C., Ronald, P.H.: the impact of perceived corporate social responsibility on consumer behavior. J. Bus. Res. **59**, 46–53 (2006)
7. Brown, T.J., Dacin, P.A.: The company and the product: corporate associations and consumer product responses. J. Mark. **61**(1), 68–84 (1997)
8. Cryer, E., Ross, W.: The influence of firm behavior on purchase intention: do consumers really care about business ethics? J. Consum. Mark. **14**(6), 421–433 (1997)
9. National Register of Non-financial Reports, http://rspp.ru/simplepage/157
10. Peskova, S.C., Boriskina, T.B.: Razvitie processov socialnogo investirovaniya v ramkax socialnoyi otvetstvennosti biznesa. J. Econ. Sain. **101**, 114–118

Job Satisfaction Level of Federal/Provincial/Semi Government Officers of Pakistan

Rao Zeeshan Aziz, Umer Asgher and Tanveer Ahmed

Abstract Job Satisfaction has now become one of the most important factors for optimal utility of Human Resource. Because of its importance, many researches have been carried out from almost all sectors. Organizations have realized the importance of job satisfaction and have included things like bonuses, awards, performance rewards and conducive working environment etc. Federal/Semi government employees are the most important people in a nation as they are the policy makers or provide the basic input for making any policy and they drive a nation as all the institutions of country are run on the policies which are formulated by them. If they are not satisfied with their jobs, then it is an alarming situation. Our basic purpose of this research was to determine and analyze the officers of Government/provincial and Semi Government organizations for their job satisfaction level. Research is based upon Salary, Fringe benefits, Working environment, Use of skills and activities, Work activities etc. Data will be analyzed for job satisfaction with respect to difference of age, gender, experience, level of employee and different types of government. In this research we have tried to evaluate the job satisfaction level of Federal/Semi government employees of Pakistan. A quantitative type of study was conducted having questionnaires developed from already researches carried out. It was kept in mind that maximum departments and people at different levels should be contacted to have a clear picture of the situation. The results show that as the grade increases, the satisfaction level also increases. It is concluded that officers specially initial grade officers are not very satisfied with their jobs.

Keywords Human resource management · Job satisfaction · Government sector · JSS

R.Z. Aziz (✉) · U. Asgher · T. Ahmed
COMSATS Institute of Information Technology, Islamabad, Pakistan
e-mail: rao.zeeshan@comsats.edu.pk

U. Asgher
e-mail: umer.asgher.eng@ieee.org

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1 Introduction

During the last many years, job satisfaction topic has been given consideration a lot and described as "the most intensively studied variable in organizational research" [1]. A number of research has been carried out in almost every country of the world and in almost all the field of life. "Job satisfaction is linked to productivity, output, organizational performance and many other factors. Job satisfaction improves productivity, enhances commitment and creativity. Also, job satisfaction must not be ignored, but the problem is that only few organizations actually consider employee job satisfaction" [2].

"To determine heath of an organization, job satisfaction can be a good measure. Job satisfaction can be defined as a positive state of emotion which results in the pleasure that a workers derive from their jobs" [3]. As the level of job satisfaction in any organisation increases its not only productivity or output increases but its strength for gaining competitive advantage also increases directly. In many organisations the human resource department works intensively to enhance the job satisfaction level of their employee to get the ultimate benefit and optimum utilisation of available human resource. It requires a lot of in depth knowledge of human behaviour, work environment, and the factors effecting the job satisfaction in any organization.

1.1 Job Satisfaction Theory

"Job satisfaction is a pleasurable emotional state resulting from the appraisal of one's job as achieving or facilitating the achievement of one's job values" [4]. "Job satisfaction can play a important role in keeping in limit problems like turnover, absenteeism, performance and the psychological distress" [5]. Lee has described that to determine the turnover of any job the best predictor is dissatisfaction of job [6]. Furthermore, Williams (1995) discovered that job satisfaction is affected by the workers benefits [7]. It is presumed in situational theories that job satisfaction is influenced by the interaction of characteristics of task, organization and individuals [8]. Situational characteristics are being evaluated by individuals before starting any job, whereas the evaluation of situational occurrences are done at later stage [9].

2 Literature Review

The behaviour and attitudes of workers with reference to their inputs is reflected by the increasing diversified availability of communication network and advanced technological environment [10]. For many years understanding the factors and its effects had been remained the prime objective of many scholars and psychologist [11]. Those workers who were paid high compensation have shown high level of

job satisfaction [12]. Most important factors of job satisfaction are salary and benefits [11]. Reward structures should be framed according to the level of competence required for job [12]. Factors like justice at work place, trainings for personnel development and team work have a very good impact on overall job satisfaction level of employees [10]. This suggests that organizational goals are not very clear in Pakistani environment and so is the job satisfaction level [10]. The high correlation or positive or negative relationship between the environment of the organization that gives the employee a feeling of being a part of the organization's larger family undermines the high job satisfaction level both positively and negatively [10]. Contrary to the researches that suggest that the collectivist cultures have high job satisfaction levels, both factors from inside and outside of the organization can contribute to increase and decrease in the job satisfaction level [11]. It is found from researches that the fringe benefits offered to the employees on job satisfaction level is seen to be rarely significant [13]. If workers individual characteristics has not been measure than the effect on job satisfaction for any specific benefit could be misleading [12]. It was found that the entire job satisfaction related to academics of persons who stayed in any specific institution for a length of service improves significantly, contrary to those who keep on changing their institutions [14]. It was found that, on an individual, dissatisfaction or satisfaction may be contributed significantly by a single factor. For example research and teaching contributes on dissatisfaction to about 17 % whereas the same has effect on satisfaction for about 25 %. It is because; people's abilities and interests differ [15]. The level of job satisfaction was found more in female employees as compared to male employee when considered the aspect of pay [16]. It was also found that job satisfaction and specific skills are negatively correlated with each other whereas in case of general skill with the satisfaction level of job is related to each other in a positive manner [17]. It has been found with research that job satisfaction level in female doctors are less than the male doctors however the result for research in case of female physicians was found opposite here they were more satisfied than the males [18]. Empirical analysing of have determined five results which are: job satisfaction is not effected by skill mismatches; the relation between job satisfaction and salary should be considered jointly; for different job aspects the level of job satisfaction, the response vary from question to question; for different jobs the individual and job characteristics has various satisfaction level; for overall satisfaction from job the content of job are the main contributing factor. In Netherland a research on the satisfaction level of workers was carried out and based on this research there were four conclusions drawn. Contents of the job were the first conclusion which was the most important factor to determine job satisfaction level. Job satisfaction level was affected by a minor degree by the factors like supervision, co workers, retirement policies and work load. The job satisfaction level change dramatically by the aspect of the job considered. Third conclusion that can be extracted from the research if different aspects of the jobs are asked in the questionnaires, the response would be different from simply asking the job satisfaction level of an employee. Last conclusion that can be extracted from this research is the relationship between wages given to the employees and the job satisfaction is direct [19].

3 Research Methodology

To evaluate the job satisfaction level of Federal/Semi/Provincial government officers of Pakistan, we have employed following method of research was adopted.

3.1 Questionnaire and Sample Size

A closed end questionnaire was developed in 1994 by Paul E. Spector and is available for noncommercial educational or research purposes. This questionnaire is also called JSS. The same questionnaire was used for this study comprised nine departments in Pakistan. The JSS was sent to 300 officers who were selected from government, provincial and semi government departments in Pakistan. The departments were selected in a manner so that all the areas of Pakistan could be included in the sample to get a much homogenous sample to the maximum possible extent. The response from the officers of these selected departments was 29 % i.e. totals 88 JSS questionnaires were received from the potential respondents.

3.2 Questionnaire

To measure job satisfaction, a questionnaire comprising of 36 questions from the variables given below was used.

Nine aspects of job satisfaction are evaluated by this Job Satisfaction Survey questionnaire evaluates and these nine dimensions combine forms the complete scale for measurement of job satisfaction. The reliability and validity of this JSS is also proven.

There were 36 questions in JSS which reflects the nine aspects of total job satisfaction. Each aspect of job satisfaction was determined by asking 4 questions. For each question a Liker Scale ranging from "Strongly disagree" to "Strongly agree" was used. There wre total 6 choices in the Liker scale, 1 being strong disagree and 6 being strongly agree with which the participants must respond.

3.3 Description of Subscales

The nine aspects of JSS to determine the overall level of job satisfaction are following:

Communication
Pay
Coworkers

Supervision
Contingent rewards
Nature of work
Promotion
Fringe benefits
Operating procedures

3.4 Validity and Reliability of JSS

The validity and reliability of JSS is being investigated many times and is well established. The nine aspects which determines the level of overall job satisfaction were related to each other from moderate to well related, for internal consistency the total score is 0.91 and for co-worker this score is minimum and its value is 0.60. A sample size of 3067 people was used and the score for internal consistency was 0.70 which is the overall average. The validity of this questionnaire is also supported by the studies carried out on single worker. Between five sub scales of the job satisfaction the correlation for supervision was found to be 0.80 and the correlation for co-worker was found to be 0.61.

4 Results and Findings

The responses were taken from the gusseted officers of Federal, Provincial, Semi and Autonomous government organizations. Departments included Army, Higher Education Commission, Pakistan Atomic Energy Commission and Federal Investigation Agency, COMSATS Institute of Information Technology, Social Security, Indus River System Authority, Water and Power Regulatory Authority, National Telecommunication Cooperation, Irrigation and Power department Punjab and Health department Punjab (Fig. 1).

The average experience of the respondents was 15 years and 7 months. The average age of the respondents was 39 years and 6 months (Fig. 2).

Highest number in percentage of respondents by government type was of Provincial government, Federal, Autonomous and Semi government respectively.

People of different grades and at different position were approached. Highest number of respondents was from BPS 18, 17, 19 and 20 respectively (Fig. 3).

Standard deviation in BPS 20 respondents is highest. That shows that this level of employees have diverse range of views. The second highest is of the BPS 17 employees. This is because the views of promotees and the officers directly induced in BPS 17 differ from each other. Standard deviation for BPS 20 is 0.89, for BPS 19 0.7, for BPS 18 0.68 and for BPS 17 is 0.72 (Fig. 4).

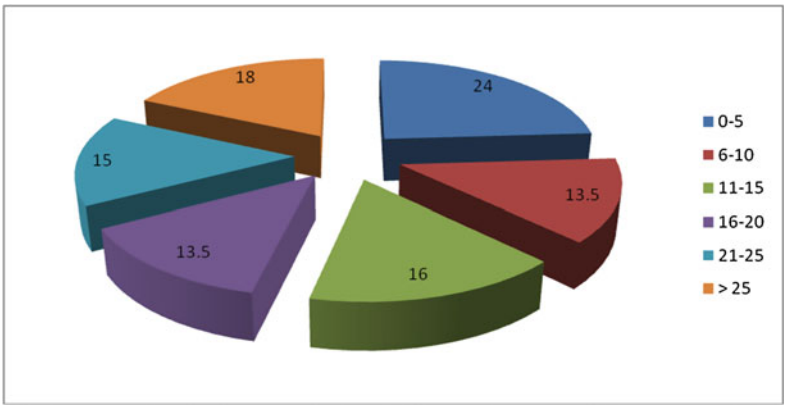


Fig. 1 Percentage of experience in years of respondents

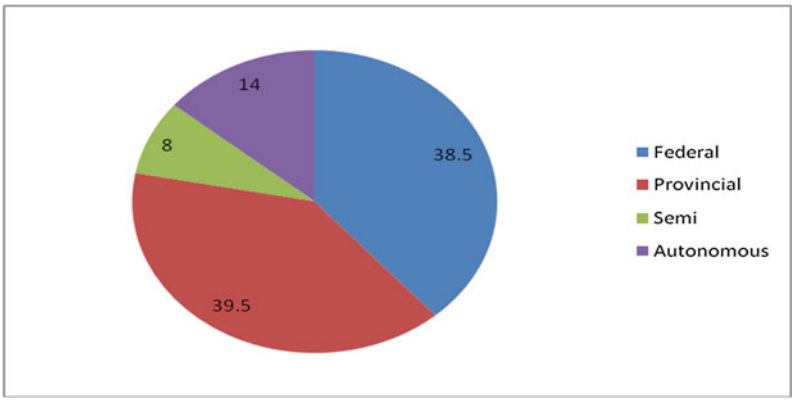


Fig. 2 Percentage of respondents by government type

The average of all the responses of different variables was collected. It showed that the most dissatisfying factor was the salary that the government sector employees are getting as the average is only 3.25. On the other hand they are very satisfied with the nature of work and think that it is important as the average of responses to questions related to nature of work is 4.38. Other variable results are of promotion 3.35, Supervision 4.28, Fringe benefits 3.55, Contingent rewards 3.71, Standards procedures 3.55, Co workers 3.98 and communication 4.27 (Fig. 5).

The overall results show that all the level of employees are not very satisfied with the pay and promotion chances, fringe benefits and procedures adopted as all of them have an average below 4. However, all level of employees seem to be very satisfied with nature of work, supervision and communication as all of them have an average of above 4 or near it. Coworkers is a boarder line case. While in variables

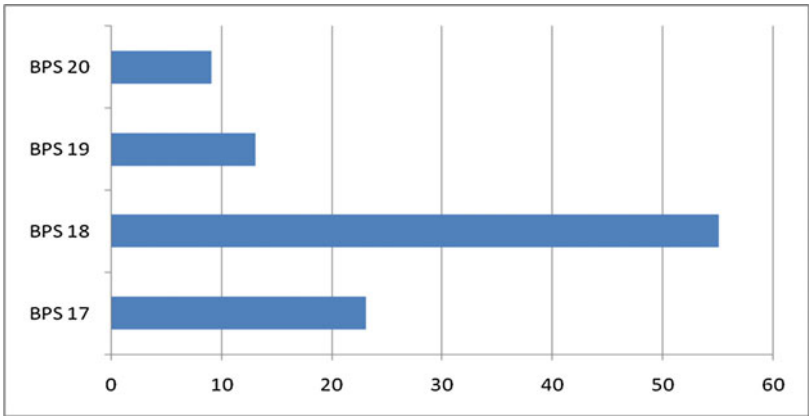


Fig. 3 Percentage of respondents by Basic Pay Scale

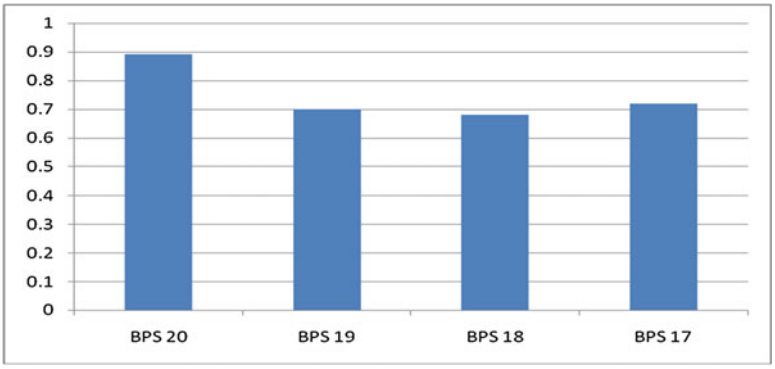


Fig. 4 Standard deviation within each Basic Pay Scale

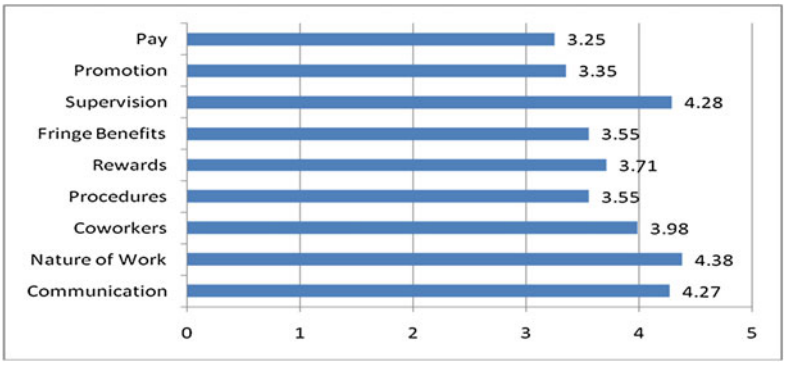


Fig. 5 Average of variables of total respondents

of coworkers, contingent benefits and supervision distinguishes between BPS 17, 18 employees and BPS 19, 20 employees. In total we can say that the BPS 17, 18 employees are not very satisfied with the jobs while BPS 19, 20 are relatively satisfied with their jobs.

The overall results show that BPS 17 has a satisfaction level of 3.79, 18 have the lowest satisfaction level with 3.68, while BPS 19 with 4.07 and BPS 20 with 4.40 shows some better results and greater job satisfaction. One thing is very important and that is in BPS 17 respondents, 29 % were promotees whose average overall satisfaction level was 4.12. If we exclude them from the BPS 17 employees responses, then the BPS 17 satisfaction level drops to 3.65 and that gives a perfect trend that more elevated the position is, more is the satisfaction level of the employee (Fig. 6).

Overall results grade wise 17–20 job satisfaction levels are for pay 3.27, 3.10, 3.55, 3.72 respectively, for promotion chances 3.14, 3.36, 3.43, 3.78 respectively, for supervision 4.79, 3.92, 4.52, 4.94 respectively, for fringe benefits 3.27, 3.59, 3.77, 3.84 respectively, for contingent benefits 3.56, 3.61, 3.98, 4.38 respectively, for procedures 3.42, 3.56, 3.64, 3.91 respectively, for coworkers 3.88, 3.77, 4.45, 4.88 respectively, for nature of work 4.51, 4.12, 4.77, 4.09 respectively and for communication 4.26, 4.20, 4.50, 5.09 respectively. The overall average is 3.79, 3.68, 4.07, 4.4 respectively.

Interestingly if we ignore the responses of promotees in BPS 17, which is 27 % of responses given by BPS 17 employees, their satisfaction level decreases to 3.65 and satisfaction level of only promotees is 4.11. If promotees are not included then we can say that the job satisfaction level increases with increase in grade. One is clear that all the level of employees don't think that there are good or excellent job satisfaction levels (Fig. 7).

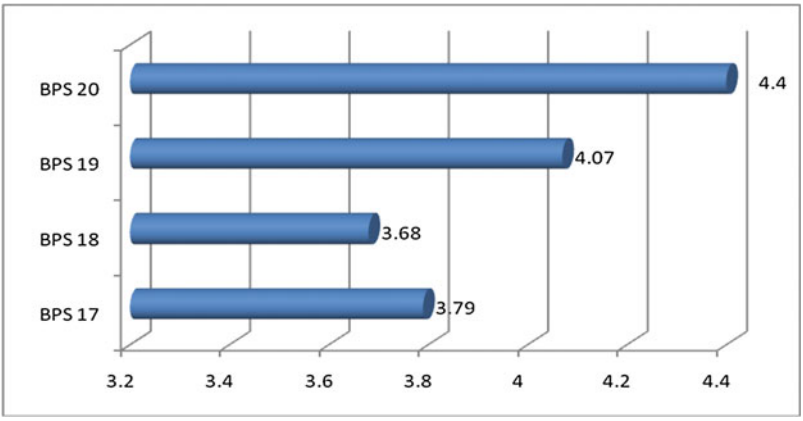


Fig. 6 Overall results

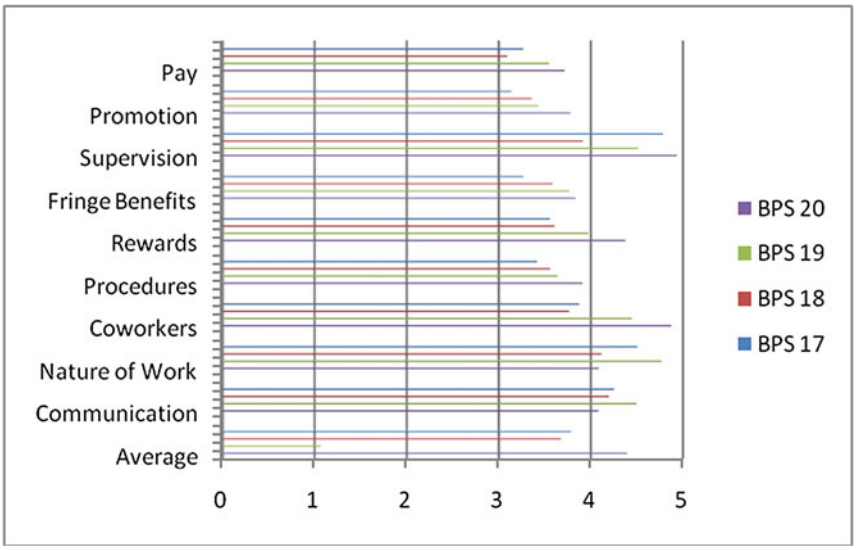


Fig. 7 Category wise job satisfaction results

5 Conclusion

From the results it is concluded that as the grade of the employee increases or the senior the position is, job satisfaction increases. However, from the overall results and the grade wise result it is evident that the government sector employees are in general not very satisfied with their jobs. This also shows that the most unsatisfying factor is the salary and the highest is the nature of work. If salary is increased, it can contribute very positively to the satisfaction level of the gusseted officers of government sector in Pakistan.

References

1. Rainey, H.G.: Understanding and Managing Public Organization, 2nd edn. Jossey-Bass Publishers, San Francisco (1997)
2. Munhurrun, P.R., Naidoo, P., Bhiwajee, S.D.L.: Employee perceptions of service quality in a call centre. Managing Serv. Qual. **19**(5), 541–557 (2009)
3. Spector, P.: Job Satisfaction: Application, Assessment, Cause and Consequences. Sage Publications, London (1997)
4. Locke, E.A.: "What is job satisfaction?" In: Paper Presented at the American Psychological Association Convention. San Francisco, 30 Aug–3 Sept (1968)
5. Chen, S.H., Yang, C.C., Shiau, J.Y., Wang, H.H.: The development of an employee satisfaction model for higher education. TQM Mag. **18**(5), 484–500 (2006)
6. Lee, T.: How job dissatisfaction leads to turnover. J. Bus. Psychol. **2**, 263–271 (1988)

7. Williams, M.L.: Antecedents of employee benefit level satisfaction: a test of a model. J. Manage. **21**, 1097–1128 (1995)
8. Hoy, W.K., Miskel, C.E.: Educational Administration: Theory, Research, and Practice. McGraw-Hill, New York (1996)
9. Quarstein, V.A., McAfee, R.B., Glassman, M.: The situational occurrences theory of job satisfaction. Hum. Relat. **45**(8), 859–873 (1992)
10. Halepota, J.A., Shah, N.: An Empirical Investigation of Organizational Antecedents on Employee Job Satisfaction in a Developing Country. Brunel Business School, Brunel University, Uxbridge
11. Determinants of job satisfaction in the UAE. A case study of the Dubai police Jassem Abdulla Dubai Police General Head Quarters, Dubai, UAE Ramdane Djebarni Glamorgan University, Pontypridd, UK, and Kamel Mellahi Sheffield University, Sheffield, UK
12. Linz, S.J.: Job Satisfaction Among Russian Workers. Department of Economics, Michigan State University, East Lansing, Michigan
13. Artz, B.: Fringe Benefits and Job Satisfaction. Department of Economics, American University of Sharjah, Sharjah, United Arab Emirates
14. Oshagbemi, T.: Is Length of Service Related to the Level of Job Satisfaction? The Queen's University of Belfast, Belfast
15. Oshagbemi, T.: Job Satisfaction and Dissatisfaction in Higher Education. Queen's School of Management, The Queen's University of Belfast, Belfast
16. Job Satisfaction and Employee Performance of Lebanese Banking Staff Alf Crossman School of Management, University of Surrey, Guildford, UK, and Bassem Abou-Zaki Nestle´ Middle East, Dubai, United Arab Emirates
17. Donohue, S.M., Heywood, J.S.: Job Satisfaction and Gender: An Expanded Specification from the NLSY. University of Wisconsin-Milwaukee, Milwaukee
18. O'Leary, P., Wharton, N., Quinlan, T.: Job Satisfaction of Physicians in Russia. St Ambrose University, Davenport, Iowa
19. Groot, W., den Brink, H.M.V.: Job Satisfaction of Older Workers. Maastricht University and "Scholar" Research Center for Education and Labor Market, University of Amsterdam, University of Amsterdam and Wageningen University, The Netherlands

Part XIV
Learning Process and Higher Education

How Do Design Blended Learning Base on Authentic Learning Theory to Enhance Pre-service Teachers' Ability in Professional Practices of the Pre-service Teacher and Instructor Point of View

Nuttaphong Kanchanachaya and Kanita Nitjarunkul

Abstract This paper aims to study pre-service teacher's opinions and education technology instructor's opinions about how to design blended learning base on authentic learning theory to enhance pre-service teachers' ability in professional. The sample were 1037 pre-service teachers and 41 education technology instructors from 11 universities in Thailand by simple random sampling. The investigation showed that: The classroom in blended learning base on authentic learning should be 11–20 students. The number of members to do activities in small groups should be 3–5 students. Instructor should create a lot of problem situation cases, and then let the student select the case to use in the group activities, the case should be consistency with the current situation, and it should be presented by video format. Instructor should follow up and evaluate the group activities by letting student reports progress form their activities periodically by themselves via online tools. Other details will be approached in the paper.

Keywords Blended learning · Pre-service teacher · Learning material · Instructional design · Authentic learning theory

1 Introduction

In the Bachelor of Education courses, pre-service teachers need to learn about the production of different types of learning material media. Now, the course involves teaching production of learning materials that focus on teaching by lecture and

N. Kanchanachaya (✉) · K. Nitjarunkul
Educational Technology Department, Faculty of Education,
Prince of Songkla University, Muang, Pattani 94000, Thailand
e-mail: kanchanachaya@gmail.com

K. Nitjarunkul
e-mail: nkanita52@gmail.com

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practice to achieve the objectives of the course. But those courses are still lack of training for the pre-service teachers how to integrate their knowledge in real life. Learning material that pre-service teachers made in the courses do not suit the real life classroom instruction [1]. At present, there is a lot of problematic issues about learning material, such as: it does not suit the needs, cannot fully convey content, not standardized, outdated and do not attract students, etc.

Learning material is important because it can help to transfer the content and experiences from teachers to students. It helps teachers and students more successfully in the teaching and learning process. Educational institutions need to focus and develop effectively learning material instructional process. Help the pre-service teachers integrate their knowledge in real life.

Authentic learning theory is a concept of learning and teaching as an interactions are blended in order to help learners to integrate the knowledge from the courses to solving real life problems, situations, and cases.

Blended learning is the concept of combining between traditional and online classes. Online technologies as a tool capacity were used to search a variety of knowledge and to exchange the knowledge among the students. Blended learning technology to be develop pre-service teacher students. Researcher plan to develop the blended learning base on authentic learning theory for pre-service teacher, the researcher have to ask for the opinions from pre-service teachers and instructors about how to design a suitable blended learning base on authentic learning theory for pre-service teacher students.

2 Objective

This paper aims to study pre-service teacher's opinions and instructor's opinions about how to design blended learning base on authentic learning theory to enhance pre-service teachers' ability in professional practices.

3 Research Sample

The sample were 1037 pre-service teachers and 41 instructors from 11 universities in Thailand by simple random sampling.

4 Methodology

This paper was conducted data during November 2014–March 2015. The data collection instrument were

1. Questionnaire for pre-service teachers about opinions of how to design blended learning base on authentic learning theory to enhance pre-service teachers' ability in professional practices. The content validity = 0.92

2. Questionnaire for instructors about opinions of how to design blended learning base on authentic learning theory to enhance pre-service teachers' ability in professional practices. The content validity = 0.97

Both questionnaires focused on 5 topics:

1. What is the size of classroom suitable to do activities in blended learning base on authentic learning theory to enhance pre-service teachers' ability in professional practices?
2. How to create small groups to do activities in blended learning base on authentic learning theory to enhance pre-service teachers' ability in professional practices?
3. How to create problem situation cases to use and how to present that problem situation case in blended learning base on authentic learning theory to enhance pre-service teachers' ability in professional practices?
4. What online tolls are suitable for interaction for interaction and activities in blended learning base on authentic learning theory to enhance pre-service teachers' ability in professional practices?
5. How should instructors follow up and evaluate the group activities in blended learning base on authentic learning theory to enhance pre-service teachers' ability in professional practices?

5 Findings

From Table 1 the pre-service teacher point of view 41.3 % think that the classroom should have around 10–20 students, 39.0 % think that the classroom should have around 21–30 students and 10.4 % think that the classroom should have around 31–40 students.

From Table 1 the instructor point of view 48.8 % think that the classroom should have around 10–20 students, 31.7 % think that the classroom should have around 21–30 students and 19.5 % think that the classroom should have around 31–40 students.

From Tables 2 and 3 the pre-service teacher point of view 33.6 % think it should be 4 students per group, 29.8 % think that it should be 5 students per group and

Table 1 Size of the classroom in pre-service teacher and instructor point of view

Size of classroom	Pre-service teacher point of view (%)	Instructor point of view (%)
Less than 10	5.5	–
10–20 students	41.3	31.7
21–30 students	39.0	48.8
31–40 students	10.4	19.5
More than 40	3.7	–

26.6 % think that it should be 3 students per group. When we focus on how to arrange the small group to do activities 45.2 % that it should be arranged by difference in the ability of the students in the small group. 26.9 % think that it should be arranged by letting students manage on their own and 14.7 % think that it should be arranged by similarity of the ability of the students in the small group.

From Tables 2 and 3 the instructor point of view 47.5 % think that it should be 5 students per group, 27.5 % think that it should be 3 students per group and 17.5 % think that it should be 4 students per group. When we focus on how to arrange the small group to do activities 58.5 % think that it should be arranged by letting students manage on their own. 26.8 % think that it should be arranged by difference in the ability of the students in the small group and 2.4 % think that it should be arranged by similarity of the ability of the students in the small group.

From Tables 4, 5 and 6 the pre-service teacher point of view 49.8 % Think that the instructor should create a lot of problem situation cases and then let the student

Table 2 Amount of small group member in pre-service teacher and instructor point of view

Amount of small group member	Pre-service teacher point of view (%)	Instructor point of view (%)
2 students/group	5.1	5.0
3 students/group	26.6	27.5
4 students/group	33.6	17.5
5 students/group	29.8	47.5
6 students/group	4.9	2.5
Others	–	–

Table 3 How to arrange the small group in pre-service teacher and instructor point of view

How to arrange the small group	Pre-service teacher point of view (%)	Instructor point of view (%)
Let students arrange by their own	26.9	58.5
Arrange by difference in the ability of the students	45.2	26.8
Arrange by similarity of the ability of the students	14.7	2.4
Others	13.2	12.3

Table 4 How to create problem situation case in pre-service teacher and instructor point of view

How to create problem situation case	Pre-service teacher point of view (%)	Instructor point of view (%)
Instructor create a lot of problem situation cases and then let the student select the case	49.8	46.3
Student and instructor discuss and create one situation to use	28.8	48.8
Instructor create problem situation case	10.9	2.5
Others	0.5	2.4

Table 5 Description of problem situation case in pre-service teacher and instructor point of view

Description of problem situation case	Pre-service teacher point of view (%)	Instructor point of view (%)
Should be consistent with the current situation	77.1	82.9
May be consistent with the current situation	22.7	14.6
No need to be consistent with the current situation	0.2	2.4
Others	–	–

Table 6 How to present problem situation cases in pre-service teacher and instructor point of view

How to present problem situation case	Pre-service teacher point of view (%)	Instructor point of view (%)
Video	52.9	61.1
Animation	24.3	25.0
Text	13.7	5.6
Picture	4.2	2.8
Others	4.9	5.5

select the case is suitable to the student, 38.8 think that the problem situation should be created and discussed by student and instructor together and 10.9 % think it should be created by instructor and 77.1 % of them think the problem situation case which one use in activities should be consistent with the current situation when we focus on how to present problem situation cases to do activities in blended learning 52.9 % think that it should be presented by video 24.3 % think that it should be presented by animation and 13.7 % think that it should be presented by text.

From Tables 4, 5 and 6 the instructor point of view 48.8 % think that the problem situation should be created and discussed by student and instructor together 46.3 % think that the instructor should create a lot of problem situation cases and then let the student select which it think is suitable with them and 2.4 % think it should be created by the instructor and 82.9 % of them think that the problem situation case which one use in activities should be consistent with the current situation. when we focus on how to present problem situation cases to do activities in blended learning 61.1 % think that it should be presented by video, 25.0 % think that it should be presented by animation and 5.6 % think that it should be presented by text.

From Table 7 the pre-service teachers point of view 40.3 % think that the discussion board should be suitable to use for interaction and do activities between members in group. 33.2 % think chatroom should be suitable to use for interaction

and do activities between members in group and 18.2 % think that blog should be suitable to use for interaction and do activities between members in group.

From Table 7 the instructor point of view 48.6 % think that chat room should be suitable to use for interaction and do activities between members in group 35.1 % think that discussion board should be suitable to use for interaction and do activities between members in group and 5.4 % think that blog should be suitable to use for interaction and do activities between members in group.

From Table 8 the pre-service teacher point of view 42.2 % think that student reports should progress from progress of their activities periodically by themselves via online tools, 40.1 % think that the instructor should create a period for the student to report their activities progress via online tools, and 5.8 % think that the instructor should ask group leader via online tools.

From Table 8 the instructor point of view 55.0 % think let student reports progress of their activities periodically by their self via online tools, 37.5 % think instructor should create period for the student report their activities progress via online tools, and 5.0 % think that the instructor should be asked form group leader via online tools.

Table 7 Online tools to/suitable to use in pre-service teacher and instructor point of view

Online tools to suitable to use	Pre-service teacher point of view (%)	Instructor point of view (%)
Chatroom	33.2	48.6
Discussion board	40.3	35.5
Blog	18.2	5.4
e-mail	3.7	2.7
Others	4.6	7.8

Table 8 How to follow up and evaluate the group activities in pre-service teacher and instructor point of view

Online tools to suitable to use	Pre-service teacher point of view (%)	Instructor point of view (%)
Let student reports progress of their activities periodically by their self via online tools	40.1	55.0
Instructor should create period for the student to report their activities progress via online tools	42.2	37.5
Instructor should be asked form group leader via online tools	17.4	2.5
Others	0.3	5.0

6 Discussion

The classroom in blended learning base on authentic learning should be 11–20 students. In the small classes, instructor and the student can spend more time "on task" and be focused on learning, with special benefits for low achievers and far lower rates of negative behavior [2]. The small group to do activities in blended learning base on authentic learning theory should be 3–5 students, and should be arranged by difference in the ability of the students in the small group. In the group which one have a variety of students they can interact more and learn from each other, can share more experience and they also can help each other to successes in task [3]. The problem situation case to use in blended learning base on authentic learning should provide an opportunity for students to take part in the qualifying situation which is used in the activity. And that case should be modern and in line with the current situation. In the problem situation case if we allow students to take a part to select situation student will get better attitude and they can select situation which one it suitable with them make them more success in learning [4]. The tools used to interact in a group activity in blended learning base on authentic learning should take chat-room discussion forums and blog. The students can use chat room discussion forum blog and several other Web tools to conduct independent and collaborative activities. Solutions to problems of using technology and learning collaboratively online included getting to know each other, respecting individual differences, negotiating meaning with others, and self-regulating [5]. Monitoring and evaluation in blended learning base on authentic learning activities should provide an opportunity for students to present the progress of the activities themselves regularly. Or may be prescribed period the students presented their progress periodically.

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References

1. Kanchanachaya, N., Suwannatthachote, P., Suwanmonkma, S.: How to enhance creative problem solving in instructional media production assessment course: a finding from needs. Acad. Serv. J. Prince of Songkla Univ., **23**(2) (2012)
2. Biddle, B.J., Berliner, D.C.: Small class size and its effects. Schools Soc.: Sociol. Approach Educ. **3**, 86–95 (2008)
3. Swing, S.R., Peterson, P.L.: The relationship of student ability and small-group interaction to student achievement. Am. Educ. Res. J. **19**(2), 259–274 (1982)
4. Jenkins, J.R., Antil, L.R., Wayne, S.K., Vadasy, P.F.: How cooperative learning works for special education and remedial students. Except. Child. **69**(3), 279–292 (2003)
5. Murphy, K.L., Cifuentes, L.: Using web tools, collaborating, and learning online. Distance Educ. **22**(2), 285–305 (2001)

Social Sciences and Humanities Researcher Development of a Higher Educational Institute in the Context of Violent Conflict in Thailand's Deep South Region

Kanita Nitjarunkul

Abstract This paper presents factors affecting social sciences and humanities researcher development of a higher educational institute in the context of violent conflict in Thailand's Deep South Region. The quantitative research was conducted using questionnaire survey and the qualitative research was conducted using focus group discussion, group interview, and in-depth interview. The purpose of finding the factors are to understand the situation of current researcher development and what have been introducing as solutions to improve the researcher development.

Keywords Social sciences and humanities research · Social sciences and humanities researcher · Researcher development · Research University

1 Introduction and Objectives

The Separatist violence in Muslim-majority region of southern Thailand has been steadily escalating since early 2004. While Thai governments claim to use patience as a principle, the insurgent capabilities are outpacing state retaliate measures causing 18,442 deaths and injuries from 15,360 violent incidents [1, 2]. The contours of resolution to the conflict in southern Thailand have long been in the public domain but successive Bangkok governments have been unable to commit to a comprehensive and decisive approach [3, 4]. In May 2015, Legislative Institutional Repository of Thailand shared an electronic document title in *The Peace Process of Southern Thailand: Comparative Study with Mindanao Case in Republic of the Philippines* recognized the cause of the violence in 5 dimensions including politics, economics, social and culture, education, and judicial administration [5]. Even

K. Nitjarunkul (✉)
Faculty of Education, Prince of Songkla University, Pattani, Thailand
e-mail: nkanita52@gmail.com

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though the insurgency has grown less lethal since 2008, there is still no sign of sustainable peace in the near future.

It is inevitable that higher educational institutes in this unrest area have been played essential roles to resolve the situation. A university founded in the area under pseudonym of Southern University (SU) has been taking a great part in providing knowledge and strategies, facilitating facilitators and mediators in every consensus on peace dialogue process and so on. Therefore, it is unavoidable for SU to move forward from Research-oriented University to Research University. To become such as a great Research University, SU had established research system operating directly under Deputy President for Research and Graduate Study. However, since SU has founded more Sciences based faculty than Social Sciences and Humanities based faculty led to an imbalance number of research conducted by faculty members. Social sciences and humanities research related to the ongoing insurgency are in such a small number comparing to scientific research.

Thus, the research aimed to investigate the factors affecting the mechanism for social sciences and humanities research development in SU.

2 Research Methodology

The factors affecting social sciences and humanities researcher development in SU were determined both quantitatively and qualitatively.

2.1 Quantitative Research

The quantitative research was conducted by collecting data using questionnaire survey. A questionnaire consisted of three parts:

- Part I: Personal information such as workload, education level, specification, research funding, research experience, etc.
- Part II: A questionnaire with 10 items aims to investigate what sort of support the faculty has given to faculty members as a mechanism for social sciences and humanities researcher development. It contained 2-item rating scale.
- Part III: A questionnaire with 20 items aims to investigate factors affecting the mechanism of social sciences and humanities researcher development. It contained 5-item rating scale questionnaire.

The questionnaire was distributed to 89 lecturers. 89 lecturers from 15 faculties of 5 campuses of the university were sampled by using purposeful sampling method. The descriptive statistics of arithmetic mean, frequencies, and standard deviation were used to describe the affecting level of each factor and the affecting the social sciences and humanities researcher development.

2.2 Qualitative Research

The qualitative research conducted via focus group discussion, group interview, and in-depth interview.

Focus Group Discussion. The focus group discussion aims to investigate the internal factors (strengths and weaknesses) and the external factors (opportunities and threats) affecting to the mechanism of social sciences and humanities researcher development. The analysis sample was the same group of faculty member using in the quantitative research part. The focus group discussion members were divided into 9 groups of 10 participants. In each group, the research team provided one facilitator to lead the discussion. Voice record and note taking were used to gather all information during the discussion. A SWOT analysis, structured planning method used to evaluate strengths, weaknesses, opportunities, and threats, were performed during the discussion.

Group Interview and In-depth Interview. The group interview aims to investigate the factors that faculty members think affect the mechanism of social sciences and humanities researcher development. For the in-depth was conducted by interviewing 10 university administrators including one Executive Vice President in research section, 9 deans from 9 social sciences and humanities faculty. Each interview takes 2–3 h. Voice record and note taking were used to gather interview information.

3 Research Findings

3.1 Quantitative Research Findings

Overall (see Table 1), at least 50 % of the sample felt that their faculty have been providing faculty as a mechanism for social sciences and humanities researcher development. More than 90 % of the sample felt that their faculty has been providing research funding to an inexperienced researcher as an encouragement. However, as high as 49 % of the sample felt that their faculty has not been providing them with experienced/skilled research mentor, which slowing down the social sciences and humanities researcher development.

Table 2 indicates that 7 of 20 listed factors are at high level affecting the mechanism of developing social sciences and humanities researcher. However, the rest of listed factors are also played an important role as they were scored at moderate level.

Table 1 List of support that social sciences and humanities faculty provides to faculty members as a mechanism to develop their research ability

Supports	N	Min	Max	Mean	SD
1. Faculty provides research funding to a new researcher	89	0	1	0.93	0.252
2. Faculty encourages researcher to attend research training organized by other institute	86	0	1	0.81	0.391
3. Faculty provides research basic needs (material, tools, infrastructure)	87	0	1	0.79	0.407
4. Faculty has a cleared target on research development policy	86	0	1	0.78	0.417
5. Faculty provides a reliable IT system to retrieve research information	88	0	1	0.68	0.468
6. Faculty allocates a cleared research load	88	0	1	0.68	0.468
7. Faculty encourages faculty member to do research in other institutes	84	0	1	0.67	0.474
8. Faculty has/build/maintain solid research networks	88	0	1	0.64	0.484
9. Faculty provides a reliable IT system as research tools	87	0	1	0.62	0.488
10. Faculty provides experienced/skilled research mentor	88	0	1	0.51	0.503

3.2 Qualitative Research Findings

SWOT analysis aims to identify the internal and external factors affecting the social sciences and humanities researcher development in SU. SWOT analysis was performed during the focus group discussion. The SWOT analysis results are presented in Fig. 1.

From group interview and in-depth interview, the results can be summarized into 5 discussion topics as followed:

Researcher Development Policy. The Vice President in research section shared that SU's researcher development policy was endorsed by the university research committee and sub-committee to contribute clarity and to set out the expectations of faculty members on their research loads as SU is heading forward to be a world-class research university. Deans agreed that they have been given the cleared goal of becoming a world-class university. However, they felt that they haven't responded to the policy at the same pace, which makes it difficult for faculty members to stand at the same understanding and developing point. University research council is responsible for scrutinizing and approving each research project with protocol regarding the benefits of students, university and especially the society. The benefits of scientific research are more concrete comparing to the social sciences and humanities research. So it is inevitable to see the university giving priority to scientific research. Faculty members agreed that another hold back for the social sciences and humanities study outcome is the difficulty of distinguishing between creation work and research work. Faculty members felt that the research administration, policy, and concept regarding the researcher development policy giving

Table 2 Affecting level of 20 factors to the mechanism of developing social sciences and humanities researcher

Factors	N	Min.	Max.	Mean	Level	SD
1. Too much teaching load	88	1	5	4.08	High	0.887
2. Lack of experienced researcher to attract a new researcher to join a research team	88	1	5	3.92	High	1.008
3. Lack of experienced research administrator to introduce research to new researcher	89	1	5	3.91	High	0.984
4. Lack of experienced/skilled research mentor	89	1	5	3.57	High	1.127
5. Lack of supporting mechanism to get research publication and utilized research application efficiently	89	1	5	3.54	High	1.012
6. Lack of research assistant system	89	1	5	3.53	High	1.159
7. Lack of teaching assistant system	89	1	5	3.53	High	1.098
8. Lack of research administrator with skill and spirits	89	1	5	3.43	Mod.	1.157
9. Lack of a mechanism to encourage researcher to participate in setting research direction and policy	89	1	5	3.34	Mod.	0.999
10. Spending too much time as a university administrator	89	1	5	3.34	Mod.	1.167
11. Researcher avoids participating in a process of setting research direction and policy	87	1	5	3.29	Mod.	1.022
12. Unequipped with necessary research material and tools	89	1	5	3.19	Mod.	1.075
13. Lack of research motivating support (awards, rewards, prize)	89	1	5	3.11	Mod.	1.081
14. Lack of cleared target and direction of research theme	86	1	5	3.09	Mod.	1.047
15. Research lacks in confidence to initiate/conduct new research	89	1	5	3.06	Mod.	1.048
16. Faculty member dislikes doing research work	89	1	5	3.06	Mod.	1.190
17. Restricted regulations/criteria of using research funding	89	1	5	2.94	Mod.	1.101
18. Restricted regulations/criteria of applying for research funding	89	1	5	2.91	Mod.	1.041
19. Inadequate research funding	89	1	5	2.83	Mod.	1.150
20. Researchers are inacceptable to research funding resources	88	1	5	2.78	Mod.	1.044

down from deans are lacking of continuity and are not included in the institutional culture. Faculty members added that there is no distinctness on loads of the faculty members, especially on the research load. No regulations or rules act to force faculty members to produce research work. It can be disturbing to see faculty administrators

	Favorable	Unfavorable
Internal Factors	Strength (S) 1. Each faculty have their own research funding. 2. Faculty members are encourage to conduct/ initiate new research. 3. Readiness of faculty members to do research both within university and between universities.	Weaknesses (W) 1. Most faculty members stuck with too much teaching load leading to giving less priority to research conducting. 2. Most faculty members prefer to avoid conducting research. 3. Lack of experienced/skilled research mentor to guide faculty members on their research. 4. No punishment of faculty members with no research load.
External Factors	Opportunities (O) 1. Extra research fund from central government supporting research associate with the insurgency in the area. 2. Research fund from research funding sources.	Threats (T) 1. The university main policy are not prioritize to social sciences and humanities research. 2. Social sciences and humanities research definition are difficult to define.

Fig. 1 SWOT analysis identifying the internal and external factors affecting the mechanism of developing social sciences and humanities researcher

asking faculty members to develop their research ability, improve their research quality, and the increase number of research work, but they have yet to produce one themselves.

Research Mentors. Vice president defined the research mentor as a person who is willing and able to share their research experience and expertise. Research mentor is one of a number of elements that affect the responsible conduct of research. Deans added that research mentor is critically important for research success. They should be able to help researcher how to manage a research agenda, how to obtain funding, how to recruit research team, how to write manuscripts, and so on. Faculty members stated that mentor also assist researcher to get better understanding of their responsibilities when they become researcher mentors to students themselves. Many faculty members think that it is essential for researcher without research experiences to get several mentors because there is no single mentor who knows everything that a researcher needs to learn in order to be successful in his or her research career path. However, with such a heavy obligation and require high qualification of being a mentor make it difficult to find at least one mentor for each research project. The university criteria of hiring mentor outside the

university members are also an obstacle because a high experienced research mentors could be of any qualification need not be Ph.D. nor titled as an associate professor. In addition, the compensation given to mentors is not attractive enough. Mentors normally get $300 per research project if it is a very successful one, if not only half which cause some faculties to faced with in short or no research mentor situation. Some faculty members felt that sometimes it is too much on the plates from the teaching loads that are why they give less priority to research conducting.

Research Funding. As stated above, SU has been pushing hard on the researcher development policy to satisfy the world-class university policy. Vice president stated that it is quite an important discussions about how funding is managed and distributed, and how such decisions are made. The arguments about levels of funding, expect most researchers to agree that more is better. Three separate funding sources are university research fund, faculty research fund, and stakeholders or outsources. The research funding is granting upon the research benefits. So, there is always a gap between the amount of research funding between scientific research and social sciences and humanities research. Faculty members agreed that they have a channel to seek for research funding from the university. One of the faculty members was bold to state that he always gets the minimum amount of the research funding range. Deans added that it is normal for scientific researchers to be granted with more research funding from university compare to the social sciences and humanities researchers grants with. For the faculty research fund, the fund is a 10 % collection of the faculty incomes or funding, which mostly came from the student enrollment, which varied and cannot expect much. Because of the high expectation from the stakeholder, the funding can be reached by only the top 2 % of the social sciences and humanity faculty members. And it normally ends up to be a private research project between researcher and stakeholder. With all the difficulties and protocols that faculty members have to battle with, they sometimes avoid conduct research work.

Research Training, Co-researching, and Research Networks. SU supports faculty members and staffs with research training and career development program annually. The university encourages faculty members to attend research-training program organized either by the university or by other institutes. In some case, rejection from university administration also can be seen if faculty members requested too often. University administrator thinks that one of a good researcher qualifications is to be able to do self-study both to discover new knowledge and to make sure they are truly understand what they had gained from each training by starting a small research project. However, it is also important to keep in mind that researcher without research experience may take a lot more time to fulfill their confidence and make the first step. For the co-researching ability, SU have built a foundation of co-researching opportunity and research network since 2004 starting from signing MOU between the universities to build a research network in southern Thailand area. Faculty deans shared that the downside of not having a strong

research-training program can affect the co-researching opportunity. It is almost impossible to see an inexperienced researcher or less experienced research conducting a co-research both within the university and between institutes. Strong co-researching between institutes generally builds a strong research network. Researchers with know-how knowledge and research experiences will have no problem finding their own research funding, recruiting research team, conducting co-research, and building research network.

Research Basic Needs. Research basic needs include research tools; data managing tools, data gathering tools, research facilities; laboratory computer, Internet access, and research vehicle support and so on. One of the core elements of conducting good research work is the research database. SU provides faculty members and staffs with both an online database system and hard copy. The central IT support is in charge of maintain and provide access to a comprehensive record of dissertations, indexing and abstracting for key library and information, journals, books, research reports, and so on. On the other hand, the hard copy database can be access and request at all 7 campuses central library. However, there are other elements that needs for research conducting like research tools and facilities. Different research team can afford different level of research basic need. Some research team has only one desktop computer, some have their own research laboratory, some have licensed data gathering/managing program, etc. Deans confirmed that every faculty members are provided with a desktop computer, a printer, and some with scanners as a plus. For Internet access, the university arranges both landline and wireless for faculty members to use it for both research purposes and teaching purposes.

4 Solutions to a Better Social Sciences and Humanities Researcher Development

To reassuring that the researcher development move forward sustainably and efficiently, short term and long term solution need to be constructed. The social sciences and humanities research unit were established as a short-term solution. The social sciences and humanities research unit set up every year to remedy the obstacles that impede researcher development. For the long-term solution, SU has planned to build the university social sciences and humanities research institute. The criteria/agreement, pros, and cons of both research unit and research institute are presented in Tables 3 and 4 respectively.

Table 3 Research unit agreements, pros, and cons

Agreement	Pros	Cons
1. Experienced and active learning researchers recruitment 2. 5 years duration 3. 1 publication in Scopus per year 4. US$30,000 research grants from SU per year 5. Seek min. US$30,000 research grants from stakeholders per year 6. Funding research grants on graduate students research (Master degree and Ph.D. Candidate) 7. Research unit performance evaluation annually	1. Improve researcher development situation 2. Increasing university publication number 3. Assuring the research quality 4. A cultivating process of the future research mentors 5. Opportunity to cultivate new researchers 6. Researchers develop a common research agenda to push, systematize, and improve the research efforts to meet with the stakeholder criteria	1. Increasing research loads to researchers 2. Failure of research unit may cause as high as US$60,000 per year 3. No ability to sign contract with international research institutes

Table 4 Research Institute agreements, pros, and cons

Agreement	Pros	Cons
1. Hub to organize research training and support 2. Equip with necessary research basic needs (infrastructure, tools, IT system) 3. Administrators and committee 4. Full-time researcher career opportunity 5. Research mentors provider	1. Strengthen social sciences and humanities researcher's research ability 2. Opportunity for co-researching between universities 3. Opportunity to build a strong research network within university and between universities 4. Ability to sign contract with international researcher institutes	1. Require a large amount of investment 2. Overlap duty with university and faculty administration in research section 3. Rely on university fund and funding agencies affecting by the low income

5 Conclusion

The factors affecting the mechanism of social sciences and humanities researcher development determined from this study is a good source that helps navigate what direction the university need to move forward to. It tells which engine is broken, which engine need be changed, where is the leakage from but the university administrators need to decide whether to repair or do spares change. The study not only point out the current problems that impede the university from becoming a great research university but also confirmed that the university still has a loose

foundation in researcher development. But the end of the day, SU needs to assure to maintain the greatness of the institution where students can find the best instructions from the best researcher.

References

1. McCargo, D.: Country Profile Thailand: Situation Report, (10 Feb 2014). Retrieved February 7, 2015, from Tony Blair Faith Foundation: http://tonyblairfaithfoundation.org/religion-geopolitics/country-profiles/thailand/situation-report
2. Panatnachee, S.: Deep South Incident Database, (2016). (http://www.deepsouthwatch.org, Editor) Retrieved 22 Jan 2016, from Deep South Watch
3. Crisis Group Report.: Thailand: The Evolving Conflict in the South, (11 Dec 2012). Retrieved 2 Feb 2016, from International Crisis Group Working to Prevent Conflict Worldwide: http://www.crisisgroup.org/~/media/Files/asia/south-east-asia/thailand/241-thailand-the-evolving-conflict-in-the-south.pdf
4. Wheeler, M.: Talking and Killing in Southern Thailand, (9 Aug 2013). Retrieved 2 Feb 2016, from International Crisis Group Working to Prevent Conflict Worldwide: http://www.crisisgroup.org/en/regions/asia/south-east-asia/thailand/op-eds/wheeler-talking-and-killing-in-southern-thailand.aspx
5. Bureau of Academic Affair, The Secretariat of the House of Representatives.: Academic Focus, (May 2015). Retrieved 2 Feb 2016, from National Reform Steering Assembly: http://library2.parliament.go.th/ejournal/content_af/2558/may2558-1.pdf

Helping College Students to Manage Stress: A Human Centered Smartphone Application for Stress Relief

Saad Almesalm, Lucas Stephane and Guy Boy

Abstract This paper discuses a major topic, i.e. "stressed students while in college", that is essential to both society and students. It includes only the first two stages of the Human-Centered Design life cycle (*Identify Needs*, *Research/Analysis*, Design, Evaluation and Delivery). The importance of this topic is revealed when we realize that stress can affect students internally and externally. In addition, knowing the possible causes of stress helps students to manage and relieve their stress. Three major factors (i.e. *academic, social and personal/family*) are identified to be the main sources of stress and each factor has sub-factors that are discussed in detail. Based on our findings and analysis, we propose two approaches for students to handle stress in college: time management systems and social support systems.

Keywords Stress · Human-centered design · Time management systems · Rewarding systems · Social support systems

1 Introduction

The term stress comes from the Latin *stringere*, that means,"to draw tight". Stress is defined as "a negative emotional, cognitive, behavioral and physiological process that occurs as a person tries to adjust to or deal with stressors" [1]. Stressors are defined as "circumstances that disrupt, or threaten to disrupt, individuals' daily functioning and cause people to make adjustments" [1]. Being stressed is a serious matter in college. It makes students unhappy and it does not allow them to enjoy

S. Almesalm (✉) · L. Stephane · G. Boy
School of Human Centered Design, Innovation and Art,
150 West University Blvd, Melbourne, FL 32901, USA
e-mail: salmesalm2014@my.fit.edu

L. Stephane
e-mail: lstephane@fit.edu

G. Boy
e-mail: gboy@fit.edu

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their moments. In fact, it enables them to react irrationally toward specific events. Stress could break up relationships between couples, friends or any other type of relationships. It is important to know that students handle stress differently, some of them coping with stress faster and more efficiently, others taking more time. Counseling and psychological services on campus support students academically and personally. However, this sort of support may fail to reach students in an efficient time. The use of smartphones has extended students' cognitive and emotional abilities beyond traditionally recognized boundaries of personal physical embodiment. Mitigations to encourage successful psychological functioning and social interactions of college students should account for this cognitive prosthesis [2]. Thus, leveraging smartphone technology may offer a solution that enables to understand and purposefully engineer successful interactions between technology, organizations and people. Therefore, it is considered that Human Centered Design (HCD) is helpful for exploring and providing a solution to the following questions:

- What are the possible causes of stress (academic, personal/family, social)?
- To what extent does stress affect college students (students engagement, students performance)?
- How can a smartphone application help reduce/manage stress?

2 State of the Art

2.1 What Is Current Situation with Students Having Stress?

Stress can impair students' knowledge by making them worry too much about exams or assignments. Being stressed during teens age years is not totally new to the society. Generally teens know about stress, but the issue here is not only to recognizing stress, but also how to deal with it. This is why our society should be concerned with this matter. The various causes of stress and the incremental number of teens being stressed emphasize and prove that teens need to be aware of stress and how to deal with the possible causes of stress in order to avoid irrational actions. Most universities in the U.S. have counseling centers for students to promote the best academic successs and to solve emotional issues students might run into. For instance, Florida Institute of Technology (FIT) provides counseling services on campus for registered students. This center assists FIT students to know themselves better, manage stress, understand lacking of self-confidence, and other stress related issues. Students need to schedule an appointment at the center and they could choose either an individual counseling or a group counseling.

2.2 How Is Technology Used in This Area?

Researches and studies were done in isolation without providing a specific solution for students. There are numerous technologies used in this field, but since we are developing a smartphone application for this research, we have only looked for solutions that fit into students' needs while in college. Most of the smartphone applications that deal with stress are designed as questionnaires, meaning a user will answer some questions then the app will tell the user about the kind of stress s/he has and show possible strategies on how to relieve it. In other words, a user can check, test or relieve her/his stress by using the app. Our proposed application is specifically designed for college students at FIT to help them reduce and manage their stress. There will be some functions such as management functions and social functions that are useful and helpful for college students. Both functions are explained in detail in the proposed solution section in this paper. Also, some of the existing applications are not free which means users need to pay certain amounts of money in order to install the apps in their phones. Stop Panic and Anxiety Help, Sleep Time–Alarm Clock, Relax and Rest Guided Meditations, and Self Help for Anxiety Management were rated as the best smartphone applications in 2014 and were designed for stress and anxiety.

2.3 Cognition and Emotion

Certainly stress affects students cognitively, emotionally and physically. The more students take care of stress, the healthier the lives they will have. Stress impairs cognition and has a massive impact on emotion. Furthermore, it lowers students' confidence making them feel unwilling to do things or discouraging them from exploring or experiencing life in college. Negative body feedback as well as negative thoughts impact attention allocation for dealing with a given task, lowering thus performance [3]. Many studies have also shown that students find it difficult to shift their attention from one task to another when they are stressed out. They may have memory deficits when the body is stressed by releasing too much cortisol, which can lead to depression too. Obviously when students are under stress, their cognitive performance will be negative and sometimes students do unintelligent things because they are stressed out [4]. Below are several possible points showing the effect of stress in students.

- Students may feel frustrated to wait for something. They may lose control of concentrating on something
- Students tend to forget things easily and they think of negative things repeatedly
- Students get discouraged and talk negatively about themselves, which makes it hard for them to make a decision

- Student's lack of sleep. As a result of this they lose energy and they become lazy to finish their work
- Students have mood swings, which means that their mood will change from being happy to sadness to probably anger

2.4 Literature Review

Some parents tend to express to their children that college is great and the experience they had themselves was wonderful without telling them much details of what they personally struggled with. Obviously, they want to give a good image of college and this is acceptable to some extent. But today college life is different and some teens are stressed just with the thought of attending college. The first year in college can be the most stressful year to students due to various events that could occur to them, including competition with other students for grades or being afraid of AIDS and many other things. To better understand how to prevent students from facing stress alone, we investigated the causes of stress and we categorized them into three groups: Academic, Social and Personal/Family. Also, we gathered the most important points that are relative to each factor and caused stress in students as shown in Fig. 1.

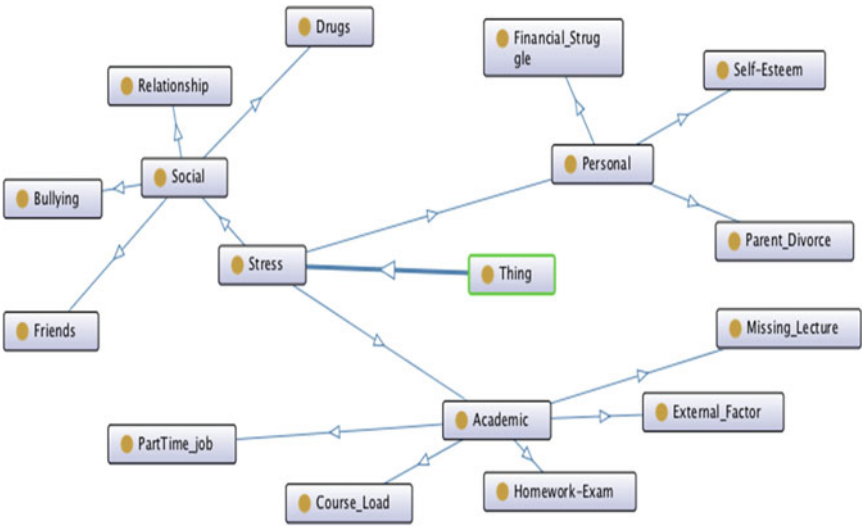


Fig. 1 Ontology of stress causes (Protégé screenshot)

2.5 Academic Stress

The main goal for students going to college is to succeed academically. They need to earn a degree with an excellent achievement, but let's state some questions: What if the students expect to earn a good grade, but they do not? What if the cost of tuition is high and they have to take more courses to graduate early, but they fail? Many possibilities here could cause stress in college students. Academic stress occurs in many ways and students are under pressure since they want to prove to themselves as well as to their family that they succeed at school. Also, some parents push their kids to boost their GPA to be accepted at respected universities, which causes a lot of stress in them. Most students desire scholarship since it helps them save money. Some teachers criticize students to the point where they feel unwelcome at school. Competing with other students can lead to stress. All these points play an important role in stress development and it is known that stress leads to depression and depression leads to suicide. Students want to be able to relieve stress and one way to do this is by understanding and knowing the possible causes of academic stress.

Homework and Exams are very critical to students because they prove and show how good or poor their academic performance is. Sometimes the assignments could be hard and sometimes they could be simple. In both cases students need to prioritize their activities to complete and submit their assignments on time. From our own experience, we have seen some friends who were not accepted in college because of their poor academic performance.

Course Load can also be a reason of great stress for students. Having many courses in a given semester is hard to deal with well because of hurrying through to accomplish the objectives. Numerous students would take additional courses in order to graduate early. This can cause students to suffer psychologically, physically, socially, and educationally. "Increased coursework stress among students with higher academic success may be related to higher self expectations for maintaining their high academic standing" [5].

Missing some Lectures can be a matter of enormous stress for some students. At times it happens that students miss the lectures for some reason or another then it becomes extremely difficult for them not only to catch up with the other students, but also to comprehend and understand those particular lectures due to which they become victims of stress. Also, students feel that missing lectures may result in their failure, which also causes more stress.

External Factors play an important role in academic stress. In fact, students do not know how to manage and maintain their good grades because of other activities unrelated to schoolwork. For example, playing video games, watching TV or surfing the web could harm students' grades only if they do not manage it well. In most cases, some students spend much time in such activities and less time on the schoolwork. These result in being stressed especially during the finals and most likely lower their academic performance.

Part-time jobs can be another major reason of stress for many students. There are many students that need to work while they go to college. Some of them need to work keeping in mind that they have to bear their educational expenses. This can be even more dangerous and risky for them. Most of the times students need to work late at night and after that do not have sufficient energy and time to study and this can badly affect their academic performance and grades. Bothering about financial issues, grades and academic performance can be a massive stressor in their academic lives. "More time spent at work can encroach on time otherwise available for studying" [5]. As one can see, one stressor can bring about another stressor to happen.

2.6 Social Stress

As humans, students are naturally social and this could be positive or negative. It is positive once they know and understand how to deal with social activities. Social stress is an important factor that leads to depression and it can come from various activities. It could come from friends, bullying, a new relationship, or alcohol/drugs. Social stress increases the fear of relationships with others and the social environment in general.

Friends play a very important role in social stress. They could help relieve the stress or increase it. For example, female teens tend to be competitive with one another, which makes the situation very stressful. Sometimes this sort of competition is not desirable. Also, female expectations are very high, so they expect their friends to read their minds and provide them with immediate help. Friendship needs to be healthy and teens in general do not really understand how to balance their relationships.

A new relationship is another factor that causes stress among students. Giving up on old friends and making new friends/relationships can be highly stressful. "Giving up or changing new friendships and developing new ones is often a stressful activity associated with college life" [5]. It is a matter of stress because students find it difficult to find someone they can trust, with whom they can share their feelings and from whom they could get emotional support.

Bullying is a serious matter that could destroy a student's life. It can lower or severely erode confidence and make one feel unhappy. Bullying occurs when someone feels forced to accept or do things more than once for other people. It starts from home to anywhere a student goes to, it could come from parents, friends, professors, or anyone else in the society. There are many forms that bullying can come in, such as calling by an undesired name, by teasing too much, by physically hurting or by being threatened.

Alcohol/Drugs Many students start consuming alcohol or drugs in order to get rid of stress. They consider it as a way to reduce their tensions but actually the intake of alcohol or drugs can make problems even worse, putting their physical and mental health at more risk. The temporary usage for eliminating their stress,

often goes for longer periods generating accustomedness and addiction through repeated usage.

2.7 Personal and Family Stress

Even a family can be a major factor that causes stress in students. There are many families who put an awesome amount of stress on students by letting them know that they have to achieve good grades. There are a few students that are the first to go to school in their families, which can put a lot of stress on a person. Families will remind the teens of this regularly, especially if they are not flourishing in their studies. There are many families who do not provide support to their children whether it is moral, emotional or financial, due to which students often lose their confidence and become victims of massive stress. These chronic stressful experiences can damage the students' brains as well as have a negative impact on their academic performance. As stated by Fish and Chew [6], students learning capacity and scholarly achievements were influenced by family problems. Therefore, the support of the family can play a critical role in the life of an individual. A supportive family can help students in healthy growth of mind and in flourishing personally as well as academically.

Self Esteem Having low self-esteem can contribute to increase the level of stress in students. There could be several reasons of having lower self-esteem such as parental divorce, lack of support from the family, financial hardships and poor relationships. The victims of low self-esteem try to keep themselves isolated from the society. They do not socialize with people and hesitate to share their problems with others. They find it extremely difficult to collaborate and cooperate with their peers even for the purpose of learning, which can ultimately result in poor academic performance.

Parent Divorce is linked with poor functioning of students. The connection between parental divorce and student stress is very obvious as it results in major changes in their lives. These stressful changes in circumstances result in lower self-esteem and poor performance in studies. Students from divorced families are more likely to be a victim of social, emotional and academic hardships.

Financial Struggles Some families fail to provide financial support to teens due to financial hardships, which put a great deal of stress on teens. They find it very difficult to manage their personal and educational expenses on their own. Lack of financial support forces them to find a part time job, which becomes even more challenging and stressful for them to cope with and perform well in their academics. Pfeiffer [5] highlights that there are numerous students who need to work while they are going to school with a specific end goal to pay for their expenses. Typically, students need to work late in the evening and thus do not have sufficient energy for studying efficiently. This can be unsafe for students as organizing over their budget issues and grades can be a massive stressor in their academic life.

3 Solution

Figure 2 explains and shows the process of the iterative HCD life cycle [7, 8]. It operates repeatedly into five stages (*Identify needs*, *Research/analysis*, *Design, Evaluation* and *Delivery*). It is important to note that this project is under development, an initial prototype being completed at this stage. Therefore, tests and evaluations are not included in this paper. In HCD, the work starts with users needs and requirements. Our work is related to the overall topic of suicide prevention, since it spans many factors such as depression, anxiety, bullying and sexual abuse. However, in order to ensure a feasible and practical solution for college students, we decided to keep the most relevant stress contributors as presented in Sect. 2 above. In order to validate the requirements for the smartphone application, we conducted an online survey to determine for which student group (e.g. freshmen, sophomore, junior and senior) our solution would be the most beneficial. Another purpose of the survey was to discover the possible causes of stress at FIT and how both genders perceive and cope with stress. The design stage comes in after collecting the information and getting deeper into how to solve the problem. The HCD lifecycle is iterative, which indicates as shown in Fig. 2 that HCD ensures sustainability in each stage.

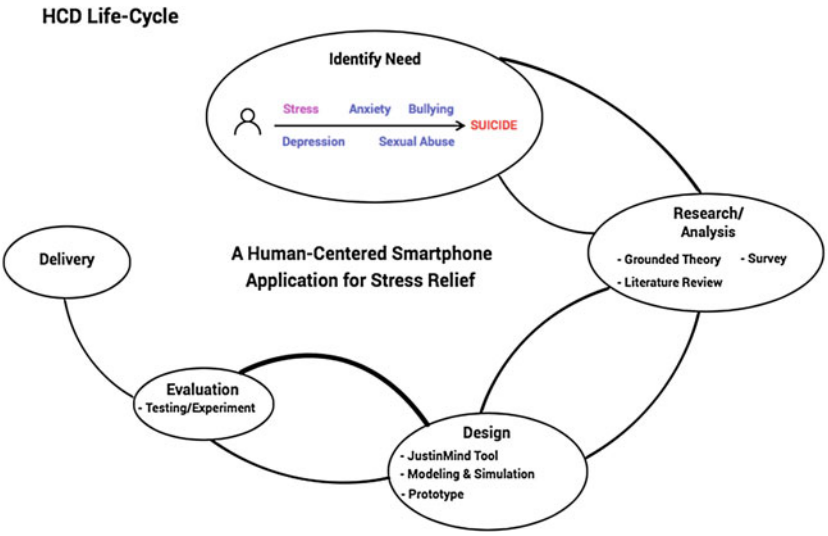


Fig. 2 Human centered design life cycle

3.1 Survey

41 online survey questions were created as an initial method used to find the potential causes of stress for FIT students. The survey helps to identify features and specifications of the proposed smartphone application. The survey was designed into four sections: student's profile, academic stress, personal stress, and social stress. The survey was emailed to all FIT students via the FIT student forum and 112 students participated in the survey, 96 of participants have completed responses and the completion rate was 86 %. The *First section* of the survey is about students' profiles, including gender, classification in college, GPA, age, and martial status. It is essential to build a generic profile to identify characteristics of users and to categorize responses into meaningful groups. The *Second section* asks questions that are related to academic stress. For example, part-time jobs, more course credits, and time management are some known factors that influence and increase stress for students in college. The *Third section* examines the potential reasons for social stress including whom and where they live, and how strong are their relationships with friends or family members. The *Fourth section* investigates the personal basis that could play an important role in developing stress. The findings of the survey were very helpful in terms of identifying what the proposed solution could be and specifying what exactly needs to be accomplished in the future. Below is a list of what we concluded and a summary of the survey results:

- The smartphone application will be implemented on IOS systems since 57.69 % of FIT participants have iPhones
- Graduate students will be excluded from the project. The responses obtained show that they are good with time management and they have no issues submitting their assignments on time
- 71.15 % of students use a calendar for reminders such as FIT, Google, phone calendar, student planner, or hand written
- Many students at FIT feel a lot of pressure in their daily academic requirements
- 53 % of students feel stressed when exams are NOT excellent and 63.62 % feel the same when their grades are low
- 29 respondents out of 100 report that they cannot concentrate when their grades are low
- Misunderstanding the materials, studying for an exam and working late on assignments are major factors that lead to stress
- Most of participants say that they talk to someone when they are stressed
- 52 respondents out of 101 agree that friends increase or decrease stress in college
- More than 50 % of participants report that part-time jobs bring a lot of stress into their lives. Also, they say that they talk to someone when making a decision
- 43 respondents out of 95 report that they need to increase their confidence level

- More than 80 % of respondents agree that taking more credits hours, having a part-time job, and missing some lectures can be a matter of enormous stress
- 57.89 % of participants say that relationships with friends can cause stress among students

3.2 Rationale for a Smartphone Application

Smartphones have become more important than ever before especially for students. We personally see many students daily on-campus having smartphones and the percentage of students having smartphones increases. Pew Research Center stated that "64 % of American adults now own a smartphone of some kind" and "15 % of Americans ages 18–29 are heavily dependent on a smartphone for online access" [9]. Smartphones are called small PCs because users can do many functions similar to using their own laptop or desktop. What makes smartphones so great are the various and wonderful applications that users utilize and benefit from. Another reason of why smartphones are great is the idea of shifting from paper based to technology-based apps. For instance, students in college use binders to organize their material, but now smartphones offer various applications for students to organize their notes. This proves that apps replace or complement the paper based student tools and provide a technology base from which students could gain more advantages. Obviously there are many benefits students gain when using smartphones. First, by organizing daily schedules, students can use smartphones to record and to remember assignments. Second, in college life almost everything has become part of the mobile environment, which means regular phones enable users to communicate, but smartphones expand the ability to let students communicate in different ways including email and instant chatting. Third, smartphones can be used anywhere and students need sometime to enjoy and refresh their minds.

Based on these observations and on our survey, we think that the students at FIT could use smartphone assistance for improving their time management. In addition, smartphones could also support in a useful way their social communication while they are away from home. We propose thus two main smartphone features for stress relief: time management and social support.

3.3 Time Management

Generally students do not know how to manage their time especially during their first year in college, which can put them into stressful situations. Also, students need to understand the importance of priorities in terms of the most important tasks to be accomplished since if not prioritized, these could be a major source of stress. Kelci stated that "time management in college does not mean getting everything

done exactly when and how you wanted it. Time management means learning how to prioritize" [10]. Planning in advance is an important aspect for students, particularly with large projects. This turns out to be a great way for students to manage their time, which decreases stress. Students are advised not to do their work at the last minute because that can cause stress in them. Limiting other activities that are not related to schoolwork is another aspect that can help students with their time management. One way to organize time and solve management issues is to create a system that helps keep track of tasks. A user could enter or select both her/his mandatory and preferred events. Thus the proposed app helps students to organize themselves and remind them their duties, but also reward them with their preferred activities and events once their duties are completed.

3.4 Social Support

Students need personal and social connections to manage their stress in college. These connections might be good at one thing but less good at another thing. Your best friend can be asked for advise of romantic relationships because s/he has enough experience, but the same friend may not really be helpful with other

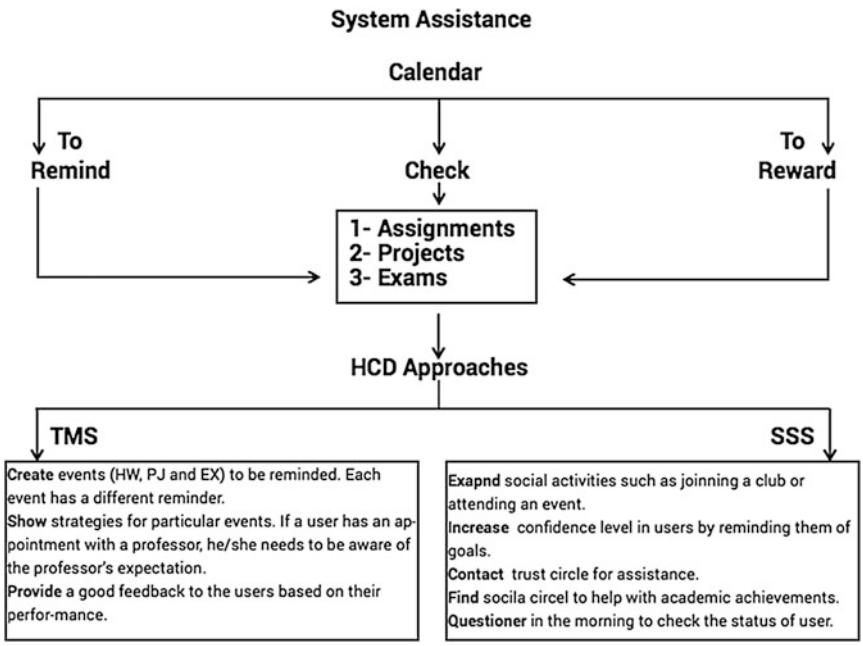


Fig. 3 Smartphone application features (TMS stands for Time Management System, SSS stands for Social Support System)

matters. College environment has a big influence on stress and if students are frustrated because of roommates, friends or any relationship issues, they are more likely to be stressed out and lose their focus on schoolwork. College is not always unhealthy; it just shows students new challenges that they never faced in previous environments. Meeting new people and sometimes from a different country and sharing the same or different values are examples of difficult challenges in college. Students need to look for social support in order to manage their stress, but first they need to identify the sources of stress. It could be coming from roommates, boy/girl friends or from classmates. Also, the social involvement plays an essential role when it comes to managing stress in college. Once they get acquainted with these, it becomes so much easier to find out a solution. Figure 3 shows and explains how both smartphone features will be used to develop our application.

4 Conclusion

Stress plays a major role in college and students need to be aware of it and able to handle it in a more efficient way. The main purpose of this paper was to find out the potential causes of stress that FIT students face while in college. Another purpose is to discover and specify the features of the proposed smartphone application. There could be various other causes and solutions that are not addressed in this paper. However, we need to start with the most adapted features for the considered population. Also, as mentioned earlier, this is an ongoing project and thus it will be implemented and evaluated in the near future. Finally, we would like to thank De Vere Michel Kiss for the help and support on editing this paper, and Nicholas Kasdaglis for informing us about the AHFE 2016 conference and supporting us with the abstract and paper submission.

References

1. Yumba, W.: Academic stress: a case of the undergraduate students. https://www.diva-portal.org/smash/get/diva2:556335/FULLTEXT01.pdf
2. Boy, G.: Cognitive function analysis for human-centered automation of safety-critical systems. In: Proceedings of the SIGCHI Conference on Human Factors in Computing Systems—CHI'98 (1998)
3. Wells, A., Matthews, G.: Attention and Emotion: A Clinical Perspective. Psychology Press, Taylor & Francis, Hove, UK (1994)
4. Best smartphone apps to combat school stress—best colleges online. http://www.bestcollegesonline.com/blog/2012/05/14/20-best-smartphone-apps-to-combat-school-stress/
5. Pfeiffer, D.: Academic and environmental stress among undergraduate and graduate college student: a literature review. http://www2.uwstout.edu/content/lib/thesis/2001/pfeifferd.pdf
6. Pariat, M., Rynjah, M., Joplin, M., Kharjana, M.: Stress levels of college students: interrelationship between stressors and coping strategies. IOSR J. Humanit. Soc. Sci. **19**, 40–45 (2014)

7. Hix, D., Hartson, R.: Developing User Interfaces: Ensuring Usability Through Product and Process. John Wiley & Sons (1993)
8. Hartson, R., Pyla, P.S.: The UX Book: Process and Guidelines for Ensuring a Quality User Experience. Morgan Kaufmann (2012)
9. Smith, A.: U.S. smartphone use in 2015. http://www.pewinternet.org/2015/04/01/us-smartphone-use-in-2015/
10. Lucier, K.: College Stress Solutions. Adamsmedia, Avon, Massachusetts (2014)

The Degree of Importance That Built Environment Postgraduate Students Attaches to Specific Library Services: A South Africa Higher Education Case Study

Katlane Seema and Clinton Aigbavboa

Abstract Over 10,000 students register each year for various postgraduate (PG) degrees across institutions in South Africa with majority of the students relying on the resources that the host universities libraries offers. This paper assesses the degree of importance that the Built Environment Postgraduate Students in a South African higher education attach to specific library services when undertaking their Postgraduate studies. The data used in this research were derived from both primary and secondary sources. The primary data were collected via an online questionnaire that was sent out to Built Environment Postgraduate students who include: Postgraduate diploma degrees, Masters, doctoral and post-doctoral students. Out of the 500 questionnaires that were sent out, an 82 % response rate was achieved, representing a total of 410 collected questionnaires. The questionnaires were analyzed using descriptive statistic procedures. Findings from the questionnaire survey revealed that research commons, learning commons, archives and the online databases were what the PG students attached the most importance as contributory to their studies. The study does not only contribute to the body of knowledge regarding the degree of importance that built environment students attaches to library services but also assist with an understanding of the factors that higher institutions need to focus on when updating services in their Postgraduate Learning Centers; the library.

Keywords Libraries · Library resources · Library services · Postgraduate research · Research productivity

K. Seema · C. Aigbavboa (✉)
Department of Construction Management and Quantity Surveying, University of Johanessburg, Johanessburg, South Africa
e-mail: caigbavboa@uj.ac.za

K. Seema
e-mail: katlaneseema@gmail.com

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1 Introduction

Universities worldwide have been acknowledged as places where knowledge generation, scholarship and innovation are advanced. Postgraduate research are considered conduits through which universities develop research capacity and also generate high skills needed for a functional economy and in addressing complex issues such as global financial recessions, climate change, poverty alleviation and more [1]. In general, post graduate research are not intended to yield ground breaking results, discovery or innovation [2, 3]. It is actually an apprenticeship into mastering systematic research process. Hence, Toncich [2] points out that the objective of postgraduate research is not to make a breakthrough invention or indeed a major scientific discovery, but rather a mechanism by which graduate students learn how to undertake a systematic investigation, founded upon work built by peers in the field and then to extend the current state of knowledge. Emphasis is placed on systematic investigation than the level of extending current state of knowledge.

A library is considered the nucleus for any research activity and an essential ingredient for a viable research system. It provides an account of previous intellectual works and functions as a breeding ground for new concepts and ideas. Library resources and facilities can be used as one of the parameters for measuring the capabilities and sophistication of postgraduate research output and productivity at the University of Johannesburg. Well-stocked and efficient libraries act as eyes or pathfinders for postgraduate researchers and provide an inspiration to venture into new areas of research. Thus, an ineffective library, on the other hand, may lead to low quality or duplication of research thus resulting in waste of financial, material and human resources and lack of motivation for postgraduate students' to become researchers and drop in productivity. Academic libraries have for centuries played critically-important roles in supporting research in all subjects and disciplines within their host universities and colleges. But the last decade has brought a sea-change in relationships between postgraduate's students and libraries. The standard practice of having libraries in universities is to provide effective information services that would enhance teaching, learning and research within the university community. Research is specifically important within the university environment because it constitutes a major determinant of the educational quality of an institution. Also, it has been stated that strong research profile adds to institutional reputation, visibility, and recognition [4].

Despite the emphasis on research, several postgraduate students' who are enrolled on dissertation based (research only) masters' or doctoral studies only use the library for research activities that relate mostly to gathering of data for their study. Most others do not engage in research activities such as journal article publication or writing of conference papers for presentation to the academic community. In as much as the university library cannot be held responsible for the attitude of most students towards research, it is worthwhile to access the role of the that PG students attached to specific university library services in aiding research

especially at the postgraduate level. Hence, Poll [5], asserts that the best testimony for an academic library's quality is the impact of the library's services on the educational process and the research results in the university. Therefore, this paper assesses the degree of importance that the Built Environment Postgraduate Students in a South African higher education attach to specific library services when undertaking their Postgraduate studies.

According to Powell [6], library use are those activities which occur primarily within the library and which reflects rather traditional library functions such as circulating books and answering reference questions. However, a robust definition of libraries use was given by Reitz, [7] who described library use as the extent to which the facilities and resources of a library are actually used by its intended users'; which forms the main thesis of this study. This definition seems more acceptable considering the fact that users now make use of the library resources without stepping into the physical library space with the aid of technology.

Library physical space according to Luzius and Web [8], provide access to technology, instructions to library use, a place to study among others. Also, Oluwatobi et al. [9] also sees it as a vital and important channel where information is acquired, processes and disseminated through the provision of appropriate information resources in its various formats either being printed or not. These considerations are no doubt important to postgraduate students even though postgraduate students may not necessarily be frequent visitors to the physical library itself as indicated in a number of studies. Hence, Greer [10] reported that "if you talk to a college admissions officer or a high school guidance counselor about things to do when you visit a college campus, one of the first things they say is to visit the libraries on campus. Bring a book or some schoolwork, sit down, and soak up the environment. Can you see yourself there for four years?" this shows the level of importance placed on the library as the centre of all academic learning. Therefore, this paper assesses the degree of importance that the Built Environment Postgraduate Students in a South African higher education attach to specific library services when undertaking their Postgraduate studies.

2 Research Methodology

The data used in this paper were derived from both primary and secondary sources. The primary data was obtained through the survey method, while the second was derived from the review of literature and archival records. The primary data were obtained through the use of a structured questionnaire survey distributed online to the respondents. The questionnaire was developed based on the reviewed literature and is not part of an existing research survey instrument. However, the pattern the services measured where used in previous studies were adopted for the development of the questionnaire. Out of the 500 questionnaires that were sent out, an 82 % response rate was achieved, representing a total of 410 collected questionnaires. The collected questionnaires were analysed through descriptive statistics in order to

meet the research objective for the study. The analysed data were presented through the of frequency distributions table.

2.1 Mean Item Score (MIS)

A five-point Likert scale was used to determine the degree of importance that Built Environment Postgraduate students attaches to specific library services in the South Africa higher education with regards to the identified factors from the reviewed literature. The adopted scales were as follows:

- 1 = Very Low (VL)
- 2 = Low (L)
- 3 = Neutral (N)
- 4 = High (H)
- 5 = Very High (VH)

The five-point scale was transformed to mean item score for each library services as assessed by the respondents. The indices were then used to determine the rank of each item. The ranking made it possible to cross compare the relative importance of the items as perceived by the respondents. This method was used to analyse the data collected from the questionnaires survey. The mean item score was calculated for each item as follows;

$$\frac{\text{MIS} = 1n_1 + 2n_2 + 3n_3 + 4n_4 + 5n_5}{\Sigma N} \quad (1)$$

Where;
n1 Number of respondents for factor number 1;
n2 Number of respondents for factor number 2;
n3 Number of respondents for factor number 3;
n4 Number of respondents for factor number 4;
n5 Number of respondents for factor number 5;
N Total number of respondents

After mathematical computations, the factors were then ranked in descending order of their mean item score (from the highest to the lowest).

3 Findings and Discussions

Findings from the usable questionnaires revealed that 80.5 % of the respondents were male, 14.6 % were female, while 4.90 % respondents choose not to respond. Findings relating to the respondents' age group revealed that 67.5 % of the respondents were in the age group of 25–34 years old, 20 % of the respondents

were 35–44 years old, 7.5 % were in the age group 18–24 and 2.4 % of the respondents were in the age group of 45–54 years old. Further results showed that 34.2 % have a Diploma as the highest qualification, 26.8 % hold a Bachelor's Degree, 22 % hold a Masters, 9.7 % have a Postgraduate Degree, 4.9 % have and Honours' Degree and 2.4 % have a Doctorate as the highest qualification. Further results revealed that 61 % of the postgraduate students have not undertaken the use of library training since becoming students of the higher institution, 34 % of the postgraduate students had undertaken the library training since becoming students of the university, and 5 % of the postgraduate students are not sure if they did take

Table 1 Library service

Library services	MIS	SD	R
Research commons	4.25	4.92	1
Information gathering centre	4.19	6.19	2
Learning commons	4.15	0.45	3
Archives	4.06	6.54	4
Circulations desk	4.03	5.97	5
Ref works	4.00	5.81	6
Library workshops	4.00	5.77	7
Team-teach (Class session with Librarian)	3.91	7.83	8
One-on-one library tour	3.79	4.88	9
WI-FI access	3.69	6.66	10
Online Database	3.67	6.15	11
Dictionary	3.66	4.85	12
Encyclopedias	3.64	3.05	13
Print journals	3.63	5.50	14
Thesis or dissertations	3.59	5.27	15
Indexes and abstracts	3.55	5.64	16
Bibliography	3.53	6.43	17
CD-ROM database	3.47	6.73	18
Books (print)	3.45	5.50	19
Internet provision	3.41	6.06	20
Electronic journals	3.41	5.86	21
Opening hours	3.38	5.94	22
Reading spaces	3.38	5.18	23
Print journals	3.37	0.45	24
Online public access catalogue	3.34	5.08	25
Library website	3.31	6.84	26
User education/training in library use	3.16	6.95	27
Referrals	3.16	5.86	28
Photocopying	3.06	5.93	29
Personal assistance of library staff	3.03	5.59	30
Inter library loan	2.94	5.50	31
Intra library loan	2.88	4.34	32

the training or not. However, 61 % of the postgraduates students revealed that they understand the library's shelving system, 24 % of the postgraduates do not understand the shelving System, while 16.0 % have never used the shelving system for an reference document search. Based on the ranking (R) using the calculated standard deviation (SD) and mean scores ($\bar{x}$) for the listed importance of library services (see Table 1), it was observed that the most used library service were the research commons (SD = 4.92, $\bar{x}$ = 4.25, R = 1), information gathering centre (SD = 6.19, $\bar{x}$ = 4.19, R = 2), learning commons (SD = 0.45, $\bar{x}$ = 4.15, R = 3), archives (SD = 6.54, $\bar{x}$ = 4.06, R = 4), circulation desk (SD = 5.97, $\bar{x}$ = 4.03, R = 5). The findings support previous studies; revealing that research skills that the researches gain from being part of the library environment also helps them with being able to know the library archives to see where books could be located and the relationship that is built between the researches and librarians during the physical space in the library may help in the long run. To some research students, being able to leave the private space to the library is another form of research as meeting with students that meet similar interests can change the way the research world is seen as informed in 2011, by the Research Information Network and Research Libraries UK. Overall, in other studies, the research common is one of the most used facility in the library. With the South African higher education having PG research centers, it proves that the university make sure that the PG students are in an area that will make them perform better with their endeavours; while easy access to the information ensures that they complete their studies in time.

4 Conclusion and Recommendations

The purpose of the study was to assess the degree of importance that the Built Environment Postgraduate Students in a South African higher education attach to specific library services when undertaking their Postgraduate studies. The literature review shown that the library resources of universities contribute immensely to the timely completion of PG studies and even in the choice of PG schools selection. The empirical results for the study revealed that built environment PG students attached high degree of importance to the following library services: research commons, information gathering centre, learning commons, archives, and the circulation desk. Other equally important services were: the library online databases, WI-FI service, printed books and referrals service. However, inter and intra library loan service were consider less important as most students rarely make use of these services. The result revealed that library resources are not just materials that are placed to help figure out what the researcher's next step is, but also a building block towards the material that is factual and also understandable. From the findings, it is recommend that the higher education should have a section that is dedicated to each department and makes it easier for the PG to know where to go to when help is needed and to find the suitable materials for their studies but also toward the specific research project.

References

1. Mutula, S.M.: Challenges of postgraduate research: case of developing countries. S. Afr. J. Libr. Inf. Sci. **77**(1), 184–190 (2011)
2. Toncich, D.: Key Factors in Postgraduate Research: A Guide for Students, 2nd edn. Create Space Independent Publishing Platform, Australia (2006)
3. Toncich, D.: Key Factors in Postgraduate Research: A Guide for Students, 3rd edn. Create Space Independent Publishing Platform, Australia (2011)
4. Azad, A.N., Sayyed, F.J.: Factor influencing faculty research productivity: evidence from AACSB accredited schools in the GCC countries. J. Int. Bus. Res. **6**(1) (2007)
5. Poll, R.: Performance, processes and costs: managing service quality with the balanced scorecard. Library Trends. Available online: http://findarticles.com/p/articles/mi_m1387/is_4_49/ai_77811352/ (2001). Accessed 12 March 2013
6. Powell, R.R.: The relationship of library user studies to performance measures: a review of the literature. Available Online: http://www.ideals.uiuc.edu/bitsream/2142/3875/2/gslisoccasionalpv00000i00181_ocr.txt (1988). Accessed 23 Sept 2013
7. Reitz, J.M.: Dictionary for Library and Information Science. Libraries Unlimited, Westport (2004)
8. Luzius, J., Web, B.: Non-traditional students' library satisfaction. Available Online: http://www.uidaho.edu/~mbolin/1ppb5nl.htm (2002). Accessed 25 July 2013
9. Oluwatobi, O., Ehioghae, M., Aluko-Arowolo, T., Olusegun, A.: Utilization of library resources for effective research output among post graduate ministerial students of Adventist University of Africa in Babcock University. Glob J. Hum Soc Sci Res **14**(6), 52–57 (2014)
10. Greer, J.: U.S News. Available from: http://www.usnews.com/education/best-colleges/right-school/choices/articles/2010/06/17/4-reasons-why-the-library-affects-your-college-choice (2015). Accessed 11 April 2015

Part XV
External Business Factors and Change Issues

Hierarchal Cabal Leadership in the Workplace

Stella Marie Rostkowski

Abstract Case Studies and Phenomenological studies repeatedly showed that the physical effects of Carpal Tunnel Syndrome (CTS) are still present in the workplace today. However, what was missing from these studies was how the effects of CTS plague an employee with CTS psychologically, psychosomatically, physically, and sociologically after they have been exposed to repeated hierarchal cabal leadership tactics from their employer in the workplace.

Keywords Human factors · Carpal tunnel syndrome · Return to work programs · Workers compensation · Ergonomics · Bullying · Hierarchal bullying

1 Introduction

Current research on CTS considers the employees from either a case study perspective or a phenomenological perspective. Research has shown that case studies surrounding CTS centered on one of two aspects of the disease. First, a case study may concentrate on what CTS is and what the employees did in order to contract CTS [1–3]. The second approach involves measuring how fast the employees returned to work and how effective they were at their jobs once they returned [4, 5]. Phenomenological studies emphasized the employees' fear of the unknown and how they contended with their fear [6–8].

Personal feelings were evident in research, which showed that CTS places stress on both the employee and the employer. Employee stress involves the employee's balancing a combination of multiple fears while trying to regain a semblance of their former life back [9]. Multiple fears for the employee occur in a cycle, which starts and ends with the fear of job loss and also includes job satisfaction and future employment opportunities. Encompassed in the employee's fear circle is the impact

S.M. Rostkowski (✉)
Capella University, 225 South 6th Street, Minneapolis, MN 55402, USA
e-mail: stella.cts.rtw@gmail.com

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that the job loss, loss of job satisfaction, and future employment opportunities will have on their private life [9].

Employers experience stress from a financial perspective. Research showed that CTS claims cost employers "over $4000 per claim" [10]. Included in this cost is the hiring of temporary personnel to replace the injured worker while they are at home recuperating from their injury [10]. Research showed that employer bias against employees with CTS is due to its medically imposed restrictions [10, 11], which are placed on the employee and to which the employer must adhere [12]. Holmgren and Ivanoff [13] stated that the reason employers have this type of bias is because they feel trapped by the societal constraints of this disease, which state the employer has to allow the employee with CTS the right to work a reduced work schedule and find tasks that they can perform.

2 Literature Review

Musculoskeletal disorders (MSDs) remain a substantial concern at work and result in considerable personal and societal burden [14]. Studies revealed that employers have gotten more sophisticated in their discrimination tactics, and their tactics are deemed socially acceptable because there are no laws that state otherwise [15, 16]. Because of the lack set regulations for return to work programs (RTW), most organizations deem this as another inconvenience associated with this disease and employ various sabotage methods to thwart the employees' progress in the RTW. Studies showed that this was accomplished through bullying, demoting the employee with CTS, and various humiliation tactics, which increased with intensity over time, such as gossiping, spreading rumors, and mobbing in order for organizations to rid themselves of this inconvenience.

2.1 Financial

The financial inconveniences noted by employers included the cost associated with the Workers Compensation claims for the employees with CTS [17] and having to hire temporary workers to do the injured employee's job [18]. Opsteegh et al. [19] argued that the financial implications, inconveniences, and disruptions brought on by having an employee with CTS in the workplace directly related to the employer's predisposed bias against employees with this disease.

Multiple studies made the argument that because employees spend a good portion of their day at work, any negativity caused by work will eventually manifest itself in symptoms that are felt mentally and exhibited physically in the employee [9, 20, 21]. Mental and physical symptoms directly linked to workplace stress included "gastrointestinal problems and sleep disorders" [21], panic attacks [22],

increased musculoskeletal injuries [23, 24], depression [23], exhaustion [25], anger, frustration, increased sick days [26], and higher employee turnover [23, 24].

2.2 Societal Influence

Societal induced pressures of keeping budgets intact, and minimalizing the appearance of CTS in the workplace resulted in the magnification of the predisposition that employers have towards employees with CTS [17]. Research showed that there was a significant financial commitment from the employer to implement a RTW program into the workplace [12], which included paying overtime to employees for working additional hours and hiring an Occupational Rehabilitation specialist.

Multiple studies by [12, 15, 27, 28] argued that because of the pressure employers received from societal influence, employers indirectly work against employees with CTS's healing processes and concentrate their effort towards eliminating employees with CTS from their organizations.

2.3 Hierarchal Bullying

Hierarchal bullying is an "abuse of power", which is directly aimed at forcing the employer's will onto the employee by getting the employee to submit to what the employer wanted through psychological mind control and manipulation [16, 18, 19, 21, 28, 29]. Hierarchal bullying "encapsulates a series of systematically negative acts that derive into social, psychological, and psychosomatic problems for the victim" [19]. Research showed that employer bullying starts with the first bullying action of public and private humiliation [20, 21, 29]. Once the employer had successfully humiliated the employee, efforts were increased to sabotage the employee's work and discredit the employee with co-workers [20, 30–32].

Several studies showed that employers sabotage employees' work by interfering in its progress [1, 22], being overly critical of the work [5, 22, 33], and giving the employee an assignment that they know the employee will not finish on time [14, 22]. The employer does this in order to create and show a pattern of the employees' work performance, which can be used to maintain control over the employee through denying vacation, or sick days, promotions, or allowing the employee to transfer to another department [9, 14]. Studies showed denying employee transfers to other departments was one of the severest of manipulations and bullying tactics on the employers part because it invoked helplessness, desperation, and made the employee feel that they had no control over the situation. Research showed that the employee felt hopeless and stuck in their position [8, 22, 30, 34, 35].

Managers have also sabotaged an employee's work efforts in order to discredit the employee with their co-workers [20]. The manager starts by talking behind the

employee's back to other co-workers about the employee's performance and uses key buzz words or phrases to invoke a negative response from the employee's co-workers. Research showed that this sabotage removes any chance of the employee gaining support or sympathy from their co-workers when the bullying intensifies [29, 30, 32, 36].

Numerous studies stated that because of the repeated abuse and humiliation endured socially for extended periods of time, bullied employees have high amounts of stress, anxiety, appear to be nervous all the time, and are insecure about their job [9]. Bullied employees were reported to have developed coping mechanisms such as grinding their teeth [5], nervous twitches [21, 28, 33], and developed dependency on "psychotropic drugs" [6].

2.4 Financial Effects of Bullying

Workplace bullying proved to be a "key ethical problem in the modern workplace" [6] and had the opposite effect of what managers were trying to accomplish by bullying their employees into conforming [36]. Studies showed that the social, psychological, and psychosomatic effects of employer bullying affected the organization's bottom line because of the waterfall of effects that bullied employees experience socially, psychologically, and psychosomatically [1, 35]. While minimal literature addressed the exact financial losses organizations experience due to bullying, literature implied that the losses to productivity [4, 5], employee turnover, excessive absenteeism, loss of product knowledge, and having to hire new personnel cost organizations between "6 and 36 billion" [14] dollars annually. Employer bullying also jeopardized the reputation of the organization [4, 18, 32, 36, 37] because of numerous lawsuits filed by bullied employees. While research showed that three-fourths of the lawsuits filed against employers for bullying were ruled in favor of the employer, the social effects of the law suit itself caused doubts about the organization with their clients [24, 36].

3 Study Purpose

The purpose of this constructivist grounded theory study was to discover how the physical, social, and emotional effects of carpal tunnel syndrome (CTS) affect employees with CTS's ability to complete an employer-sponsored return to work (RTW) program. This was accomplished using a constructivist approach to examine relationships between employees and their managers. The results found in these relationships were compared to the business needs, healthcare needs, and personal needs showing how they compared, contrasted, and coexisted with each other. Study Participants consisted of 12 employees with CTS in three separate companies who were participating in their employers' RTW programs. The premise behind

using three separate companies was to show the differences and similarities within the study between participants and employers as they relate to CTS.

The guiding question for this study was,

RQ1: How do the effects of employer's bias towards employees with CTS affect the employee's successful completion rate of a RTW program?

4 Methodology

This study used a constructivist grounded theory methodology to learn about the participants' individual experiences. Constructivism "asserts that realities are social constructions of the mind, and that there exist as many such constructions as there are individuals" [38]. Additionally it has been argued that data does not provide a window on reality. Rather, reality is discovered from the "interactive process and its temporal, cultural, and structural contexts" [39].

Through the use of an interpretivist lens, "mere statements of uniformities of social behavior in responses to social influences" [38] were captured, depicted, and used to illustrate the direct influence on the outcome for an employee with Carpal Tunnel Syndrome in a Return to Work program.

5 Sampling

The population for this study consisted of 12 people in three separate companies who have been afflicted with CTS and were absent from work for an extended period of time in order for their injury to heal. Participants in this study were either returning to work after their extended absence or had returned to work within the last 45 days and were actively participating in their employer's RTW program. In order for employees with CTS to participate in this study, they had to provide proof of a previous licensed physician's diagnosis of CTS.

6 Data Collection

Participants in this study answered semi-structured and open-ended interview questions about their experience with CTS in the workplace, how they dealt with having CTS in the workplace, how they were treated in and out of the RTW program by their employer and co-workers, and why they felt their disease had a direct impact on how they were treated by their employer and co-workers. In conjunction with the semi-structured interviews, observations served to confirm or question the participants' responses and shape the open-ended interview questions.

7 Instrument

Data collection instruments for this study were (a) semi-structured interviews, (b) observations, (c) and open-ended questions. Semi-structured interviews served as the foundation for the creation of open-ended questions and to learn about the initial background of the participants' experience with CTS in the workplace. Observations, in conjunction with the semi-structured interviews, confirmed or supplemented the participants' responses. Observations also suggested open-ended interview questions.

Open-ended questions used for the interviews allowed participants to open up about their experience of how they dealt with having CTS in the workplace, how they were treated in and out of the RTW program, and why they feel they were treated the way they were. This in turn addressed the research questions and illuminated how the effects of the psychological, psychosomatic, and sociological served as the exposition of why a participant acted and reacted the way he or she did within the Return to Work program.

8 Results and Findings

Data analysis in this study utilized the microanalysis techniques and procedures outlined by Strauss and Corbin [40]. The general framework utilized for data analysis involved open coding, axial coding, and selective coding.

8.1 Open Coding

Open coding was conducted in this study by repeatedly comparing the participants' interview responses against their body language during their semi-structured and open-ended interviews. The comparison provided information about meaning and categories for the investigated participants Kantianisms. During Open coding reoccurring groups, themes, or incidents were grouped together and given the same conceptual label. During open coding, 19 concepts were coded; Unwilling Acceptance, Anger, Fear of the unknown, medication, Feeling Different from Co-Workers, Wanting to be treated like they were before, Physical Limitations, Envy, Blame, Envy, Self-loathing, Anxiety, Depression, Physical Pain. Coping Strategies, Denial, Loss of Self-esteem, Loss of Self-worth, Feelings about their Future and their Career, Feelings about CTS.

8.2 Axial Coding

Axial coding was used to sort the 19 identified concepts into six categories that repeatedly emerged. The six categories allotted the researchers insight into the psychological, psychosomatic, and sociological effects of CTS within the workplace. Within the six categories, three to five subcategories emerged, and these were used to provide further insight into these effects.

8.3 Selective Coding

Through selective coding, the participants' words and actions depicted a story, which revealed an insider's perspective on how CTS affected employees on psychological, psychosomatic, and sociological levels both in and out of the RTW program and within their personal lives. Once the core categories and their relationships to each other were identified, a hypothesis was formed based on the relationships, which revealed the invariable nature societal influence has on this disease.

9 Conclusion

Through the participants' recollections and stories, the employees with Carpal Tunnel Syndrome words helped to reveal and depict the essence and influence that the physical, psychological, psychosomatic, and sociological aspects of CTS have on each other and how they influence an employee's day-to-day physical and psychological workplace activities. Findings in this study provided physical, psychological, psychosomatic, and sociological insight into the social existence and non-acceptance of this disease in the workplace.

The six core concepts found in this study, (a) helplessness [14, 29, 35, 41], (b) physical symptoms [2, 15, 36, 42], (c) psychological symptoms [15, 43, 44], (d) physical and psychological symptoms [42, 45], (e) loss of self-esteem [34, 45–48], and (f) waiting for the inevitable [15, 49], provided insight into the psychological, psychosomatic, and sociological effects of CTS within the workplace.

References

1. Atroshi, I., Lyren, P.E., Gummesson, C: The 6-item CTS symptoms scale: a brief outcomes measure for carpal tunnel syndrome. Qual. Life Res. **18**, 347–358 (2009)
2. Hammond, A., Harriss, A: Impact of carpal tunnel syndrome. Occup. Health **64**, 14–16 (2012)

3. Idris, M.A., Dollard, M.F., Yulita: Psychosocial safety climate, emotional demands, burnout, and depression: a longitudinal multilevel study in the Malaysian private sector. J. Occup. Health Psychol. **19**, 291–302 (2014)
4. Baldwin, M.L., Butler, R.J.: Upper extremity disorders in the workplace: costs and outcomes beyond the first return to work. J. Occup. Rehabil. **16**, 303–323 (2006)
5. Glaso, L., Vie, T.L., Holmdal, G.R., Einarsen, S: An application of affective events theory to workplace bullying: the role of emotions, trait anxiety, and trait anger. Eur. Psychol. **16**, 198–208 (2011)
6. Brotheridge, C.M., Lee, R.T.: Restless and confused: emotional responses to workplace bullying in men and women. Career Dev. Int. **15**, 687–707 (2010)
7. Clay, C., Olitt, R.: Peer power: transforming workplace relationships. Wiley, New York (2012)
8. Dale, L., Barkley, A., Bayless, S., Coleman, S.D., McDonald, B., Myszkowski, J., Phipps-Stevens, L: Experience of cumulative trauma disorders on life roles of workers and family members: a case study of a married couple. Work **20**, 245–255 (2003)
9. Hasselberg, K., Jonsdottir, I. H., Ellbin, S., Skagert, K: Self-reported stressors among patients with exhaustion disorder: an exploratory study of patient records. BMC Psychiatry. **14**, 1–10 (2014)
10. Gilbreath, B.: Educating mangers to create healthy workplaces. J. Manag. Educ. **36**, 166–190 (2012)
11. Welch, L.S., Haile, E., Boden, L.I., Hunting, K.L.: Impact of musculoskeletal and medical conditions on disability retirement: a longitudinal study among construction roofers. Am. J. Ind. Med. **53**, 532–560 (2010)
12. May, D.R., Li, C., Mencl, J., Huang, C.-C: The ethics of meaningful work: types and magnitude of job-related harm and the ethical decision-making process. J. Bus. Ethics **121**, 651–669 (2013)
13. Holmgren, K., Ivanoff, S.D.: Supervisors' views on employer responsibility in the return to work process: a focus group study. J. Occup. Rhabil. **17**, 93–106 (2007)
14. Wiedmer, T.L.: Workplace bullying: costly and preventable. Delta Kappa Gamma Bull. **77**, 35–44 (2011)
15. Fevre, R., Robinson, A., Lewis, D., Jones, T: The ill-treatment of employees with disabilities in British workplaces. Work Employ. Soc. **27**, 288–307 (2013)
16. Gholipour, A., Sanjari, S.S., Bod, M., Kozekanan, S.F.: Organizational bullying and women stress in workplace. Int. J. Bus. Manag. **6**, 234–241 (2011)
17. Côté, D., Coutu, F.-M: A critical review of gender issues in understanding prolonged disability related to musculoskeletal pain: how are they relevant to rehabilitation? Disabil. Rehabil. **32**, 87–102 (2010)
18. Persson, J., Bernfort, L., Wahlin, C., Oberg, B., Ekbert, K: Costs of production loss and primary health care interventions for return-to-work of sick-listed workers in Sweden. Info. Health **37**, 771–776 (2014)
19. Opsteegh, L., Reinders-Messelink, H.A., Schollier, D., Groothoff, J.W., Postema, K., Dijkstra, P., U., van der Slusi, C.K: Determinants of return to work in patients with hand disorders and hand injuries. J. Occup. Rehabil. **19**, 245–255 (2009)
20. Law, R., Dollard, M.F., Tuckey, M.R., Dormann, C: Psychosocial safety climate as a lead indicator of workplace bullying and harassment, job resources, psychological health and employee engagement. Accid. Anal. Prev. **43**, 1782–1793 (2011)
21. Selenko, E., Batinic, B.: Job insecurity and the benefits of work. Eur. J. Work Organ. Psychol. **22**, 725–736 (2013)
22. Tracy, S.J., Lutgen-Sandvik, P., Alberts, J.K.: Nightmares, demons, and slaves: exploring the painful metaphors of workplace bullying. Manag. Commun. Q. **20**, 148–185 (2006)
23. Miranda, H., Kangas, L.K., Heliovaara, M., Leino-Arjas, P., Haukka, E., Lira, J., Juntura, E. V.: Musculoskeletal pain at multiple sites and its effects on work. Occup. Environ. Med. **67**, 449–455 (2009)

24. Roscigno, V., Hodson, R., Lopez, S: Workplace incivilities: the role of interest conflicts, social closure and organizational chaos. Work Employ. Soc. **23**, 747–773 (2009)
25. Koukoulaki, T.: The impact of lean production on musculoskeletal and psychosocial risks: an examination of sociotechnical trends over 20 years. Hllnc. Inst. Occup. Health Saf. **45**, 198–212 (2013)
26. McFarlane, A.C.: The long-term costs of traumatic stress: intertwined physical and psychological consequences. World Psychiatry **9**, 3–10 (2013)
27. Welch, L.S., Haile, E., Boden, L.I., Hunting, K.L.: Impact of musculoskeletal and medical conditions on disability retirement: a longitudinal study among construction roofers. Am. J. Ind. Med. **53**, 532–560 (2010)
28. Wheeler, A.R., Halbesleben, J.R.B., Shanine, K: Eating their cake and everyone else's cake too: resources as the main ingredient to workplace bullying. Bus. Horiz. **53**, 553–560 (2010)
29. Hauge, L.J., Skogstad, A., Einarsen, S: The relative impact of workplace bullying as a social stressor at work. Scand. J. Work Psychol. **51**, 426–433 (2010)
30. Martin, C.J.H., Martin, C: Bully for you: harassment and bullying in the workplace. Br. J. Midwifery **18**, 25–31 (2010)
31. McCormack, D., Casimir, G., Djurkovic, N., Yang, L: Workplace bullying and intention to leave among schoolteachers in China: the mediating effect of affective commitment. J. Appl. Soc. Psychol. **39**, 2106–2127 (2009)
32. Montes, A., Muniz, N.M., Leal-Rodriguez, A.L., Leal-Millan, A: Workplace bullying among managers: a multifactorial perspective and understanding. Int. J. Environ. Res. Public Health **11**, 2657–2682 (2014)
33. Vie, L.T., Glasø, L., Einarsen, S: Health outcomes and self-labeling as a victim of workplace bullying. J. Psychosom. Res. **70**, 37–43 (2010)
34. Rugulies, R.: Studying the effect of the psychosocial work environment on risk of ill health: towards a more comprehensive assessment of working conditions. Scand. J. Work Environ. Health **38**, 187–192 (2012)
35. Vickers, M.H.: Bullying, disability and work: a case study of workplace bullying. Qual. Res. Organ. Manag. **4**, 255–272 (2009)
36. Samnani, A.K., Singh, P: 20 years of workplace bullying research: a review of the antecedents and consequences of bullying in the workplace. Aggression Violent Behav. **17**, 581–589 (2012)
37. Martin, W., LaVan, H: Workplace bullying: a review of litigated cases. Empl. Responsib. Rights J. **22**, 175–194 (2010)
38. Guba, E., Lincoln, Y.: Fourth Generation Evaluation. Sage, Newbury Park, CA (1989)
39. Charmaz, K.: Constructing Grounded Theory. Sage, Los Angeles, CA (2014)
40. Strauss, A.L., Corbin, J: Basics of Qualitative Research: Techniques and Procedures for Developing Grounded Theory. Sage, Newbury Park, CA (1998)
41. De Cuyper, N., Baillien, E., De Witte, H.: Job insecurity, perceived employability and targets' and perpetrators' experiences of workplace bullying. Work Stresses **23**, 206–224 (2009)
42. Stojanova, N.: The regulation of workplace bullying in Victoria: is legislation required? Labour Ind. **24**, 146–160 (2014)
43. Anderson, M.F., Nielsen, K., M., Brinkmann, S: Meta-synthesis of qualitative research on return to work among employees with common mental disorders. Scand. J. Psychol. **38**, 93–104 (2012)
44. Finne, L.B., Knardahl, S., Lau, B: Workplace bullying and mental distress: a prospective study of Norwegian employees. Scand. J. Work Environ. Health **37**, 276–287 (2011)
45. Niedhammer, I., Simone, D., Degioanni, S., Drummond, A., Pierre, P: Workplace bullying and psychotropic drug use: the mediating role of physical and mental health status. Ann. Occ. Hyg. **55**, 152–163 (2010)
46. Nixon, A.E., Mazzola, J.J., Bauer, J., Krueger, J.R., Spector, P.E.: Can work make you sick? a meta-analysis of the relationships between job stressors and physical symptoms. Work Stresses **25**, 1–22 (2011)

47. Persson, J., Bernfort, L., Wahlin, C., Oberg, B., Ekbert, K: Costs of production loss and primary health care interventions for return-to-work of sick-listed workers in Sweden. Info. Health **37**, 771–776 (2014)
48. Pransky, G., Benjamin, K., Hill-Fotouhi, C., Fletcher, K.E., Himmelstein, J: Occupational upper extremity conditions: a detailed analysis of work-related outcomes. J. Occup. Rehabil. **12**, 131–138 (2002)
49. Cöté, D., Coutu, F.-M: A critical review of gender issues in understanding prolonged disability related to musculoskeletal pain: how are they relevant to rehabilitation? Disabil. Rehabil. **32**, 87–102 (2010)

Simulating the Outcomes of Contracts: A Visual Interface Supporting Start-Up Financing

Daniela Alina Plewe and He Lee

Abstract The potential of visualizations for negotiating and representing contracts has been explored in current research around the innovation of law. Visualizations help to increase transparency of legal matters and contribute not only to a better understanding of agreements, but to the overall deal-design. We propose a visualized simulation displaying the outcomes of complex start-up investment agreements at various points in the future. By capturing the standard variables of start-up financing term-sheets, the system supports the pre-negotiation phase between entrepreneurs and investors. Relying on the agent-based modeling framework NetLogo, we facilitate dynamic simulations with parties entering their own priorities and assumptions about the other side. We believe such a tool could prove useful on crowd-funding platforms with their increase of investor-founder relationships. In further research, specific contracts may be tested with populations of entrepreneurs and investors, yielding insights on the desirability of various deal structures.

Keywords Contracting · Contract visualization · Venture financing · Proactive law · Strategic interfaces · Online deal-making · Smart contracts

1 Introduction

Innovating the practice of law and making contracts and the process of contracting more transparent has been addressed in various discourses around legal technologies. Research activities include smart contracts [1] that automate the implementation and execution of contracts, as well as "preventive law" [2] that aims to avoid unnecessary litigation. In our previous research [3], we argued that focusing on the

D.A. Plewe (✉) · H. Lee
National University of Singapore, University Scholars Program,
18 College Avenue West, Singapore 138593, Singapore
e-mail: danielaplewe@nus.edu.sg

H. Lee
e-mail: lee.he@nus.edu.sg

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actual "deal-design" is essential to improving the overall outcome of contracting. We also made a point that new forms of knowledge representation beyond written text, such as graphs and other visual artifacts, are effective tools for negotiations. We elaborated how visualizations, visual interfaces, and perhaps even visual narrations such as comics, can facilitate better deal-design and support the negotiations leading towards it. A simulation like the one proposed could be another addition to an "integrated deal-design system" we outlined previously [4].

Based on these premises, we explore an interactive interface aimed at simulating the outcome of contracts. Visualizations can reduce the complexity of contract terms and facilitate collaborative interactions between negotiators by simulating the various outcomes of certain terms of a contract. Such interfaces and simulations may also serve as tools to "test" computer coded software contracts (e.g. smart contracts). Philosophically speaking, a contract organizes future "possible worlds" and the state in which the parties would find themselves in at certain points in time. In other words, they organize counterfactuals [5], which are derived from the decisions captured in the present when the contract is signed.

Depending on the complexity of the agreement, counterfactuals can be rather difficult to envision, especially if they involve a variety of variables affecting different parties at different situations in the future. With a visual simulation, we believe that the various counterfactuals can be explored during the important pre-negotiation or negotiation phase [4], while determining the "spirit of the deal" [6]. This increases the understanding of the implications of a contract and thereby serves the goal of better deal-design: if parties know precisely and can exactly describe the future worlds they may be in, they can potentially make better-informed decisions when entering into an agreement.

We chose start-up financing as a promising domain to build a visual interface to simulate the "possible worlds" of contracts known as term-sheets. In the complex start-up financing process, the economic realities in the future are rather difficult to anticipate, especially if there are various investors joining at various times with various degrees of involvement.

For the prototype presented here, we model some of the most common venture capitalist agreements as described in "Venture Deals" [7]. A dashboard based on sliders and buttons allows for the variation of standard parameters and displays the outcome in separate windows.

Since the interface makes use of the NetLogo Agent Based Modeling framework, we are prepared to expose the various contracts to different populations of entrepreneurs and investors (thereby being able to model different attitudes towards risk, ownership etc.) over various iterations. Both parties (investors and entrepreneurs) can enter their own preferences (e.g. risk profile, ownership preferences, amount of control over the start-up), and make assumptions about the other party. Over various iterations, the software generates future scenarios serving as a heuristic tool for strategizing and decision-making; e.g. we offer an "Ownership Calculator" and an "Investment Return Calculator".

A system like the one proposed could prove relevant for crowd-funding platforms, where a multitude of entrepreneurs and investors meet online. We believe

that simulating the potential outcomes of contracts may especially help inexperienced investors and entrepreneurs to optimize their decisions regarding an agreement. In the future, crowd-sourcing platforms could offer standard contracts and users could actually compare them via simulations—or users could actually negotiate and customize their contracts.

Section 2 delineates the dashboard of the proposed prototype. In Sect. 3, we elaborate on how the prototype, as an Agent Based Model, could be extended to help test and compare contracts and make an argument why such a system could be useful for crowd-funding platforms. We conclude with ideas on further research in Sect. 4.

2 Visual Interface for Entrepreneur-Investor Contracts

Based on General Systems Theory [8], we begin with a basic set-up of an investment system with two classes of participants, i.e. "agents" which are distinctly and logically identifiable: entrepreneurs and investors. An entrepreneur posts an idea within the system, while an investor funds an idea within that same system. After differentiating, a list of characteristics that each class of agents possesses is parameterized. Instantiated agents take on values for those parameters that may be different from other agents.

We rely on Feld and Mendelson's "Venture Deals" [7] for the description and general structure of the parameters, where contract terms are divided into the "Economic" and "Control" terms that subsume important aspects of the relationship between entrepreneurs and investors. Examples of Economic terms include price, liquidation preference, and employee pool. Examples of Control terms include board of directors, protective provisions, and drag-along agreement. Two other standard concepts of financing, "rounds" and "liquidation events", are included too. The former refers to injections of capital (e.g. pre-seed, angel, seed, round A, round B etc.), while the latter refers to events such as bankruptcy, an acquisition, or an IPO.

The prototype focuses primarily on the Economic terms as they can be quantitatively defined and accurately captured via mathematical logic. In contrast, since the Control terms are generally qualitative in nature, the way they are parameterized in the prototype is subjective and likely inaccurate in representing real-life financing.

The prototype provides an interactive visual simulation of start-up financing by investors across iterative rounds until a liquidation event occurs. It seeks to be a helpful tool for users to explore and understand the meaning and implications of contract terms used in term sheets via a more intuitive and readable and understandable way—as opposed to studying written contracts [9]. Moreover, there are currently no models specifically catered to entrepreneur-investor contracts within the NetLogo Models Library [10] and NetLogo User Community Models [11]. Thus, the prototype can serve as a useful addition to the current corpus of NetLogo models.

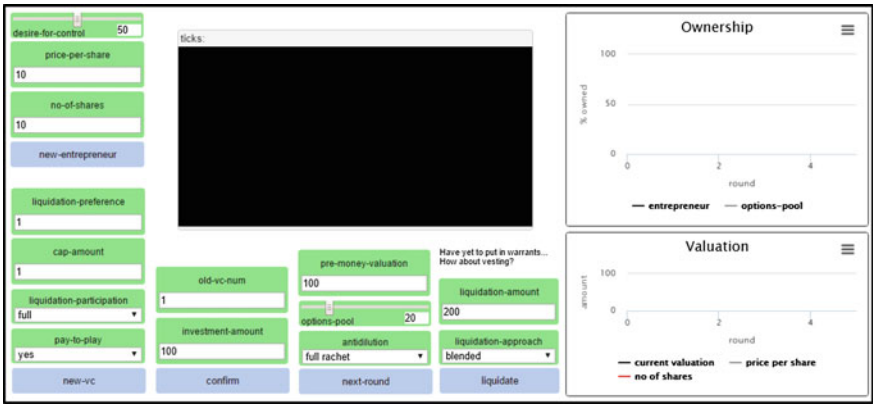


Fig. 1 Screenshot of the prototype with a display of the relevant parameters

Basic interactive charts are displayed as the output of investor-entrepreneur agreements across successive financing rounds. The prototype can generate a full text-based term sheet if connected with the relevant templates of contract editing software. There is currently a variety of such systems available in a highly competitive market. These software systems range from template-based approaches, to initiatives such as Legalese [12] that aim to allow for "programmed" specifications of contracts, to smart contracts [1] that automate the implementation and execution of contracts.

The dashboard we offer here could either be designed in accordance with all relevant parameters of a domain (i.e. in contexts other than financing agreements), or could perhaps in the future be automatically extracted from contracts, or like in the case of Legalese [12] and smart contracts, illustrate the variables in coded contracts (Fig. 1).

In order to represent the relevant parameters of a potential financing agreement, a new entrepreneur is instantiated with his or her contribution of capital[1] (indicated by the price per share multiplied by the number of shares issued). For each round of financing, a new investor (i.e. venture capitalist) can be included. Each investor can take on different values for the different sliders/input-boxes (e.g. type of liquidation preference). The charts on the right ("Ownership" and "Valuation") are dynamically updated upon each round of financing. They serve as monitoring benchmarks used to gain a quick and intuitive understanding of the state of the "future world" and the aggregated influences of all involved parties' financing-related actions starting from the first financing round. A liquidation event is finally reached, and distribution of capital to all parties can be observed (e.g. in an IPO). The prototype can be "re-played" repeatedly using different values for each parameter to explore different "future worlds".

[1]We do not consider the entrepreneur's non-capital assets, such as IP etc.

The actual appearance of this dashboard is limited by the design choices NetLogo offers. For a future version, we would plan a properly designed interface with customized forms and colors. Regarding the expressiveness and correctness of visualizations as per Bresciani and Eppler's criteria [13], we acknowledge some potential limits and emphasize that we do not naively promote a replacement of written contracts. However, we argue that through such a dashboard display, the understandability of contract terms and their implications can be increased. Simulations like the prototype proposed can be considered as decision support systems based on Plewe's "Strategic Interfaces" [14].

2.1 *Example 1—Ownership Calculator*

The prototype is useful for entrepreneurs that want to quickly examine how their ownership of the start-up (in percentage terms) changes across iterative financing rounds.

For example, suppose that an entrepreneur (represented by the human figure at the top-left of the centered "playing arena" in Fig. 2.) invests $100,000 (10,000 shares at $10 each) into the start-up. We consider this the first round of financing. Because he or she is the only investor currently, his or her ownership of the start-up is 100 %. Suppose an investor (top-right human figure) invests $100,000 (10,000 shares at $10 each) in the next financing round, but also imposes an option pool of 20 %. After this round, the entrepreneur's ownership drops to 30 % (as seen in the Ownership chart in Fig. 2.), entailing a decrease in total personal value from $100,000 to $60,000 (30 % of $200,000). This phenomenon is known as dilution, and is generally not preferable to the entrepreneur. Real life scenarios of dilution are much more complex and tedious to calculate.

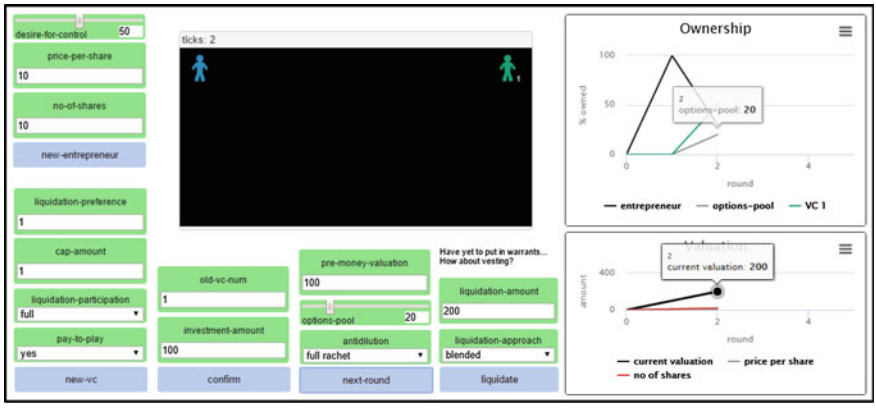


Fig. 2 Use of the prototype as an ownership calculator

The simulation thus allows the entrepreneur to quickly test many different "what-if" investment scenarios to heuristically define an allowable limit on dilution. This can assist him or her to make more well-informed and purposeful decisions when entering into legal contracts with investors. Visualizing the simulation, as per the prototype, graphically depicts the outcome using interactive charts.

Comparing this dashboard with commonly used excel-based "capitalization tables", one may note that the mechanics are similar but the representation is different: the system here is an interactive display, while excel-based capitalization tables tend to be static and cannot "play through" or visualize a full simulation of many financing rounds like the prototype.

2.2 *Example 2—Investment Returns Calculator*

While the previous example views the investment scenario from the perspective of the entrepreneur, the prototype can also be utilized from the perspective of an investor. We extend Example 1 to include an additional investor in the next financing round, and assume that the objective of both investors is to maximize the amount of received capital upon a liquidation event (e.g. start-up bankruptcy) (Fig. 3).

Paralleling Example 1, the simulation can allow the investor to quickly test many different "what-if" investment scenarios to heuristically define an allowable limit on investment returns. It assists him or her to better understand the upside/downside potential of investing in the start-up, given a change in state and increased complexity of the scenario across time. This knowledge can guide the investor in deciding whether to engage with the start-up, the timing of investment, and the terms of the financing contract.

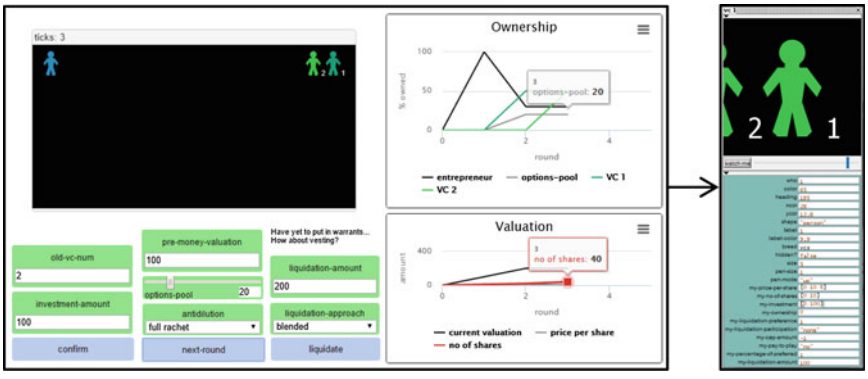


Fig. 3 Use of the prototype as an investment returns calculator (*left*), and drilled-down view of one investor to examine his or her received capital after a liquidation event (*right*)

3 Agent-Based Modeling of Start-up Financing Scenarios

We chose the NetLogo framework to not only simulate the relevant parameters as described above, but to also allow for an agent-based set-up where each party *participates as an agent* in a modeled virtual world—much like an avatar character in a Massive Multiplayer Online Role-Playing Game (MMORPG). While in the current prototype users can play simulated scenarios with assumed counterparties, we envision for a future extension of the system where users "play" and "socialize" in a virtual world, interacting with other real-life agents through the simulations.

Each run of the simulation can be treated as one "mini-game". Parties first enter the mini-game playing arena based on their role as entrepreneur or investor at the start of the simulation, run through the simulation by entering values relevant to their role, and exit the playing arena once the simulation is over. They can play mini-games at any time, with any party, and as many times as desired. For example, entrepreneur "A" can play one mini-game with Investor "B" on Day 1, play another mini-game with the same Investor "B" on Day 2, and engage with Investor "C" at a different time and in a different context. Each of the three mini-games can lead to different and unique simulation outcomes.

Input values in each mini-game capture the assumptions, objectives, and expectations of the playing agent. These data can be stored, aggregated, and analyzed by the software. With successive mini-games, or with input interfaces that feed data into the software from external sources, the captured historical data can allow for a prediction mechanism to suggest particular contract terms deemed to be attractive to particular entrepreneurs and investors for usage in future financing scenarios.

This is a departure from standard offline contracting scenarios which necessitate enumerating all possible contractual clauses to deterministically cover each and every possible "future world" envisioned by entrepreneurs and investors at a current point of time. Instead, the software iteratively and heuristically scopes down the sample space of possible "future worlds" into smaller and smaller subsets across each financing round in one mini-game, and across multiple mini-games.

The user, who acts as an agent in the modeled world, can thus explore different financing scenarios and events, look up other agents (entrepreneurs or investors) to analyze and make assumptions about them, and characterize him-/her-self based on behaviors in the world or through explicit profile options. Ultimately, the goal is for each agent to be digitally assisted towards finding his/her favorite contract terms and sweet spot for each financing scenario.

A further extension of the system is to translate a mini-game into an actual contract. If there is agreement over a "future world" or outcome in a mini-game, the contract terms and values for that mini-game can be mutually locked in by participating agents, upon which the software can translate a virtual agreement into an automatically generated physical text-based written contract.

3.1 Application for Crowd-Funding Platforms

One application of the prototype (along with its extensions) is to integrate it as a product feature into Internet-based Crowd-Funding platforms, which is possible since it has been "computationalized" as a piece of software. Such peer-to-peer financing platforms have seen large and sustained growth in recent years and rival traditional venture capital as a viable alternative for start-up financing [15]. The target audience that it would likely appeal to most would be non-sophisticated retail investors on such platforms.

Moreover, several standard "flavors" of contract terms could be made available for users to choose and use within the software as well. They are akin to the plethora of ready-made "plain vanilla"-version term sheets used at some start-up accelerators like Y Combinator.

We do note that Crowd-Funding platforms currently act as 3rd parties that provide the "online venue" for entrepreneurs and investors to enter into contracts. Such a characterization is based on Kickstarter's [16] and Indiegogo's [17] legal terms and conditions. Entrepreneur-investor contracts are ultimately mutually determined by the entrepreneurs and the investors. The platforms do not seek to mediate and be responsible for these contracts, or settle any entrepreneur-investor disputes over the contract. At best, they clarify the obligations of each party when a contract is entered into. Whether contract obligations are eventually fulfilled depend largely on the parties involved. Thus, use of the software can be *optional*. Nonetheless, the software can still additionally aid the Crowd-Funding platforms' utility to automate and expedite the contracting process.

4 Conclusion

As a first step, we have modeled mostly the quantitative aspects of financial agreements, which are prone to be displayed in graphs and dynamic tables. In order to generalize the approach of simulating or displaying the outcomes of contracts, one may have to develop a visual language for the generation of the variety of qualitative scenarios, i.e. "possible worlds", which a contract describes.

We believe that this approach together with a visual language displaying legal matters can contribute to the various trends of legal innovation, ranging from smart contracts, template-based systems, computer coded contracts, to overall ambitions of making legal practice more accessible and transparent. In the foreseeable future, contracts are meant to serve humans' business relationship needs, and therefore human factors should be mastered by innovative legal technologies.

References

1. Szabo, N.: Nick Szabo—the idea of smart contracts. In: Nick Szabo's Papers and Concise Tutorials. http://szabo.best.vwh.net/smart_contracts_idea.html
2. Haapio, H.: Introduction to proactive law: a business lawyer's view. Scand. Stud. Law **49**, 21–34 (2006)
3. Haapio, H., Plewe, D., de Rooy, R.: Next generation deal design: comics and visual platforms for contracting. In: Internationales Rechtsinformatik Symposion (IRIS), Salzburg, p. 8 (2016)
4. Plewe, D., de Rooy, R.: Integrative deal-design: cascading from goal-hierarchies to negotiations and contracting. J. Strateg. Contract. Negot. (JSCAN) (2016)
5. Lewis, D.: Causation as influence. J. Philos. **97**(4), 182–197 (2000)
6. Lax, D., Sebenius, J.: 3-D negotiation: powerful tools to change the game in your most important deals (2006)
7. Feld, B., Mendelson, J.: Venture Deals: Be Smarter Than Your Lawyer and Venture Capitalist, 1st edn. Wiley, Hoboken (2011)
8. Von Bertalanffy, L.: General System Theory: Foundations, Development, Applications. George Braziller, New York (1969)
9. Heinicke, A., Liao, C., Walbaum, K., Bützler, J., Schlick, C.: User centered evaluation of interactive data visualization forms for document management systems. In: 6th International Conference on Applied Human Factors and Ergonomics (AHFE 2015) and the Affiliated Conferences, AHFE 2015, Las Vegas, vol. 3, pp. 5427–5434 (2015)
10. CCL: NetLogo Models Library. http://ccl.northwestern.edu/netlogo/models/index.cgi
11. CCL: NetLogo User Community Models. http://ccl.northwestern.edu/netlogo/models/community/index.cgi
12. Wong, M.W., Haapio, H., Deckers, S., Dhir, S.: Computational contract collaboration and construction. In: Schweighofer, E., et al. (eds.) Proceedings of the 18th International Legal Informatics Symposium IRIS 2015. Österreichische Computer Gesellschaft OCG, Wien 2015, Vienna, pp. 505–512 (2015)
13. Bresciani, S., Eppler, M.: The pitfalls of visual representations: a review and classification of common errors made while designing and interpreting visualizations. SAGE Open **5**(4), 1–14 (2015)
14. Plewe, D.: Towards strategic interfaces. In: Wichert, R., van Laerhoven, K.J.G. (eds.) CCIS, Heidelberg, vol. 227, pp. 19–24 (2012)
15. Massolution: Global Crowdfunding Market to Reach $34.4b in 2015, Predicts Massolution's 2015cf Industry Report. http://www.crowdsourcing.org/editorial/global-crowdfunding-market-to-reach-344b-in-2015-predicts-massolutions-2015cf-industry-report/45376
16. Kickstarter: About—Kickstarter. https://www.kickstarter.com/about
17. Indiegogo: About US| Indiegogo. https://www.indiegogo.com/about/our-story

The Effect of Social Rewards and Perceived Effectiveness of e-Commerce Institutional Mechanisms on Intention to Group Buying

Margaret Meiling Luo and Sophea Chea

Abstract Previous studies have stressed the functionality and usability of group buying systems, although few studies have focused on social and psychological factors and the business perspective of online group buying. We believe that factors related to consumer psychology, relation exchange, and institutional mechanisms have not been fully explored by previous studies. These psychological and consumer behaviors are crucial for marketers seeking to increase sales rates. The phenomena are worthy of attention, given the potentially significant market gains offered by this novel business model. This study focuses on the application of social rewards in the group buying context and identifies the issue in the context of online group buying by incorporating factors such as reciprocity, reputation, trust, satisfaction, and perceived effectiveness of e-commerce institutional mechanisms (PEEIM). These factors are identified as critical factors affecting both online and physical shopping. With an online survey, we perform PLS analysis and the results suggest that PEEIM has significant effect towards online group buying intention. The results also suggest that SET factors contribute substantial impact to customer's online group buying intention. Theoretical and managerial implications were discussed.

Keywords Online group buying · Social rewards · Intention to use · Trust · Perceived effectiveness of e-Commerce institutional mechanisms

M.M. Luo (✉)
Department of Information Management, National Chung Cheng University, No.168, Sec. 1, University Rd., Min-Hsiung Township, Chia-yi County 621, Taiwan, ROC
e-mail: luo@mis.ccu.edu.tw

S. Chea
Business and Information Management, Delaware Valley University, 700 E Butler Ave., Doylestown, PA 18901, USA
e-mail: Sophea.Chea@delval.edu

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1 Introduction

Online group buying has become popular with the emergence of U.S.-based sites such as Groupon, launched in 2008. The term group shopping refers to social or collective buying where items can be purchased at significantly reduced prices when enough buyers participate in the purchase. The transaction proceeds only when the required number of buyers is reached. Significant savings can be made by purchasing more products together to reduce the price [1]. This popular trend in online shopping experienced significant growth during 2010 and 2011. In the United States and Europe, online group buying is highly popular and successful, and is based on a simple but powerful concept: consumers enjoy receiving significant discounts on premium products, although merchants are only willing to provide these discounts if they can sell high quantities [2]. A CNN report in 2010 indicated that this concept has motivated a new category of "group buying" websites, at least one of which may be valued at more than US$1 billion. In Canada, local merchants offer their services at a discount of between 30 and 90 %. Online group buying websites are also experiencing rapid growth in Asia [3]. In China, more than 1,215 group buying sites have been launched and the total transaction value of the Groupon-type market is projected to reach RMB $980 million (US $147.6 million) [4]. Group buying is the fastest growing e-commerce activity (21.2 %) in 2012–2013. In first and second quarters of 2013, the number of buyers in China increases 28 million [5].

This study attempts to understand the most crucial factors influencing consumer continuous intention to engage in repeated online group buying. This study addresses the questions of (1) whether reciprocity, reputation, altruism are antecedents of satisfaction that influence consumer intention to engage in online group buying; and (2) whether PEEIM is an moderating factor affecting consumer intention to engage in online group buying. In the following sections, studies on social rewards and PEEIM literature are reviewed and the results of previous related work are subsequently presented.

2 Literature Review

2.1 Social Rewards

Individuals typically expect reciprocal benefits, such as personal affection, trust, gratitude, and economic return when they act according to social norms. Therefore, interpersonal interactions from a cost-benefit perspective are an exchange where actors acquire benefits [6]. The social exchange model identified social rewards in psychology [7] and organizational behavior [6, 8], by analyzing human behavior and relationships to determine social structure complexity. With an emphasis on the significance of norms, specifically social institutions and formal inter-organizational

exchange behavior, the social exchange model states that people and organizations interact to maximize their rewards and minimize their costs [9]. Related theories of exchange continued to emerge after the advent of the social exchange model, including exchange behaviorism [7], the exchange network theory [8], exchange structuralism [6], and the exchange outcome matrix [10]. Previous studies have developed several social reward factors based on the concept that exchange can provide benefits. The significance of these factors has been ranked from high to low as follows: reciprocity, reputation, and altruism [11]. Reciprocity, reputation, and altruism are likely to provide perceptions of social rewards so this study attempt to investigate whether these factor determine intention toward online group buying.

Reciprocity. Reciprocity is frequently interpreted as quid pro quo behavior [12] and is well established in philosophical, psychological, and sociological discourse. The concept is based on how social exchange is made through interpersonal behavior. A stable relationship is driven by exchange [7, 13] and can be a more generalized exchange when returns are not necessarily immediate or in kind, but where a balance of exchange is achieved over time [7].

Reputation. Reputation refers to the degree to which a person believes that social interaction potentially enhances personal reputation. In the majority of cases, a knowledge owner wanting to create an image of "a wise person" is often willing to share knowledge. The knowledge provider enriches the knowledge of the recipient while retaining their own knowledge. Thus, the knowledge provider obtains additional intangible assets, including a better reputation, increased personal status, and an increased positive feeling from being a provider.

Altruism. Altruism referred to the degree to which a person is willing to increase other people's welfare without expecting returns. Altruism, reciprocity, reputation, and trust have a positive effect on attitudes [14]. Social rewards that an individual will obtain from altruistic behaviors will encourage him/her to engage in sharing and collaborative behaviors.

2.2 The Effect of Perceived e-Commerce Institutional Mechanisms (PEEIM)

The effects of e-commerce institutional mechanisms have been studied mainly in the context of initial online purchase; however, a recent study found that the effects remain strong in the online repurchase context [15]. Perceived E-Commerce Institutional Mechanisms (PEEIM) refers to an online customer's general perception that safeguards exist in the e-commerce environment to protect him/her from potential risks in online transactions. Structural assurance and institutional structure are consistently found to directly promote initial trusting belief in an online vendor [16–18] due to trust transference [19] and cognitive consistency [20]. Trust transference happens when the perceptions of the trustee are affected by one's perceptions about the security of the transaction context. Cognitive consistency occurs

when consistent perceptions of the trustee are affected by one's perception of institutional mechanisms [21]. Structural assurances are also found to directly affect initial purchase intention. Secondhand information from trustworthy third parties helps customers to feel assured about transacting with an unknown vendor [16, 22, 23]. A recent study found that PEEIM's effect towards intention diminishes when trust is high in web-mobile [21].

2.3 Satisfaction, Creativity, Trust, and Purchase Intention

In IS, satisfaction is conceptualized as end user satisfaction with systems and a crucial criterion for IS success. Satisfaction is noted in many IS studies as the response of end-users toward system attributes and service quality [24–26]. Satisfaction and attitudes are both affective measures [27] that are used interchangeably. Trust is defined as "the willingness of a party to be vulnerable to the actions of another party based on the expectation that the other will perform a particular action important to the trustor, irrespective of the ability to monitor or control that other party" [28]. Trust has been widely studied across various academic domains. It has been conceptualized as a belief in an e-seller that results in behavioral intentions [29–31] and has been viewed as a set of specific beliefs primarily associated with benevolence, competence, and integrity of the other party [29, 30, 32, 33]. Creativity is derived from the Latin word creatus. Webster's dictionary defines creativity as "given the existence" and "out of nothing" and "originality." Creative products often characterize novelty and appropriateness; otherwise, they are general products. Product creativity is defined as the concept of novel ideas and a novel product with competitive advantage [25, 34–36]. Intention is defined as the degree of customer perception that a particular online group buying behavior will be performed. This study applies the theory of reasoned action (TRA), which asserts that beliefs influence attitudes that subsequently influence intentions [37].

3 Research Questions

To test the explaining power of our research model, we ask the following research question:

How well does an integrated social rewards and PEEIM model explain the repurchase intention of the online group buying (OGB) users?

Alone with the research question, we derive hypotheses from related work:

- H1: Consumer reciprocity is positively associated with consumer satisfaction with vendors that provide OGB services.
- H2: Consumer reputation is positively associated with consumer satisfaction with OGB.

- H3: Consumer altruism is positively associated with consumer satisfaction with OGB.
- H4: Consumer trust is positively associated with consumer satisfaction with vendors that provide OGB services.
- H5: Consumer trust is positively associated with consumer intention to engage in OGB.
- H6: Vendor creativity is positively associated with consumer intention to engage in OGB.
- H7: Perceived effectiveness of institutional mechanisms (PEEIM) negatively moderates the relationship between trust in an online vendor and repurchase intention.
- H8: Perceived effectiveness of institutional mechanisms (PEEIM) positively moderates the relationship between customer satisfaction and trust in the vendor.

4 Method

A survey design was used for data collection. The study was performed in Fall, 2015 in a major Taiwan university. Students who enrolled in a 400 level IT course and grad students participated the online survey. They receive extra credits for participation. A total of 70 subjects were recruited for our study. The questionnaire developed through pre-validated measures and was further developed via a pretest. The English version of questionnaire was translated into Chinese and then back translated into English. The Chinese version of questionnaire was tested with 35 undergrad students and 24 graduate students. They were asked to read along the questions and then note down the sentences/phrases which they do not understand. The questionnaire items were reworded based on the results of the pretest. An online version of the survey was then developed by using the Google doc. An email message with the URL of survey was sent to subjects and the data were collected in a week.

5 Results and Discussion

A partial least squares (PLS) analysis using PLS Graph (Version 3.0) was conducted to examine the reliability and validity of the measures. In first study, the loading pattern was highly consistent, with most loadings above 0.70. In second study, all loadings were above 0.70. Figure 1 show the regression coefficients and variance explained. In the research model, satisfaction is postulated to have effect on trust which in turn predicts repurchase intention to online group buying. The Moderating role of PEEIM is significant.

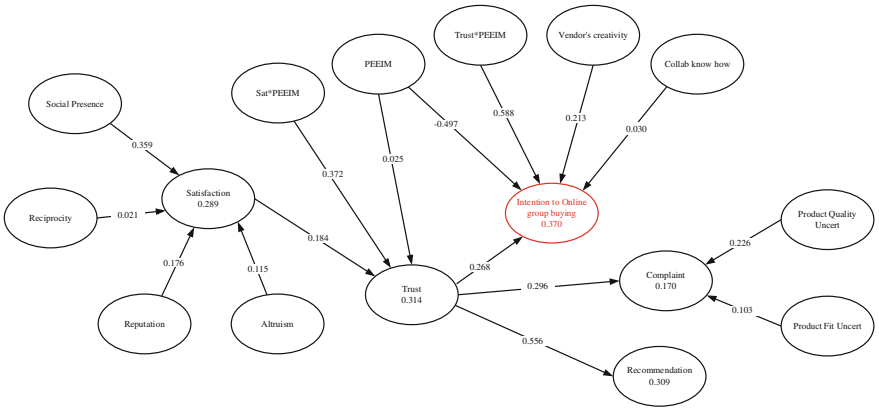


Fig. 1 Study results

6 Conclusion

The primary intellectual merit of the study rests on developing and testing a research model which advance the knowledge of online group buying behaviors. Testing the model with a variety of samples simulating a real-world situation where the Internet-based information service is being adopted will help us to pursue the goal of bring new theoretical perspective from social theories to IS. As we pursue this goal, we demonstrate that this study have significant broader impacts. First, the theoretical model under investigation benefit practitioners in continuously developing functionalities that provide the most meaningful impacts towards the online group buying. Secondly, the study can serve as a critical starting point for future scientific investigation of technologies in customer context as the electronic commerce revolution continues to grow.

References

1. CTVglobemedia. http://www.marilyn.ca/Technology/TechSho ing.aspx
2. Pressitt, Ubuyibuy. http://pressitt.com/smnr/uBuyiBuy.com-Brings-Online-Group-Buying-to-Consumers-in-Hong-Kong-Taiwan-on-June-28-2010/1737/
3. CNN. http://articles.cnn.com/2010-04-15/tech/cashmore.group.buying_1_web-buying-sites?_s=PM:TECH
4. NetworkWorld. http://www.networkworld.com/news/2010/112910-online-group-buying-taking-off.html
5. Market Intelligence & Consulting Institute (MIC). http://ecommercetaiwan.blogspot.tw/
6. Blau, P.: Exchange, and Power in Social Life. Wiley, New York (1964)
7. Homans, G.: Social behavior as exchange. Am. J. Sociol. **63**, 597–606 (1958)
8. Emerson, R.M.: Power-dependence relations. Am. Sociol. Rev. **27**, 31–41 (1962)

9. Salam, A.F., Rao, H.R., Pegels, C.C.: An investigation of consumer-perceived risk on electronic commerce transactions: the role of institutional trust, and economic incentive in a social exchange framework. In: Americas Conference on Information Systems. Baltimore, MD, USA (1998)
10. Emerson, R.M.: Power-dependence relations. Am. Sociol. Rev. **27**, 31–41 (1962)
11. Davenport, T., Prusak, L., Wills, G., Alani, H., Ashri, R., Crowder, R., Kalfoglou, Y., Kim, S.: Working Knowledge. Harvard Business School Press, Boston (1998)
12. Frazier, G.L., Rody, R.C.: The use of influence strategies in interfirm relationships in industrial product channels. J. Mark. **55**, 52–69 (1991)
13. Pervan, S., Bove, L., Johnson, L.: Reciprocity as a key stabilizing norm of interpersonal marketing relationships: scale development, and validation. Ind. Market. Manag. **38**, 60–70 (2009)
14. Davenport, T.H., Prusak, L.: Working Knowledge: How Organizations Manage What They Know. Project Management Institute (1997)
15. Fang, Y., Qureshi, I., Sun, H., McCole, P., Ramsey, E., Lim, K.H.: Trust, satisfaction, and online repurchase intention: the moderating role of perceived effectiveness of e-commerce institutional mechanisms. MIS Quart. **38**, 407–427 (2014)
16. McKnight, D.H., Choudhury, V., Kacmar, C.: The impact of initial consumer trust on In-tentions to transact with a web site: a trust building model. J. Strateg. Inf. Syst. **11**, 297–323 (2002)
17. Pavlou, P.A., Gefen, D.: Building effective online marketplaces with institution-based trust. Inf. Syst. Res. **15**, 37–59 (2004)
18. Vance, A., Elie-Dit-Cosaque, C., Straub, D.W.: Examining trust in information technology artifacts: the effects of system quality and culture. J. Manag. Inf. Syst. **24**, 73–100 (2008)
19. Stewart, K.J.: Trust transfer in world wide web. Organ. Sci. **14**, 5–17 (2003)
20. Abelson, R.P., Aronson, E., McGuire, W., Newcomb, W.J., Rosenberg, M.J., Tannenbaum, P. H.: The Theories of Cognitive Consistency: A Sourcebook. Rand-McNally, Chicago (1968)
21. Suna, Y., Shen, X.L., Wang, N.: Understanding the role of consistency during web-mobile service transition: dimensions and boundary conditions. Int. J. Inf. Manag. **34**, 465–473 (2014)
22. McKnight, D.H., Cummings, L.L., Chervany, N.: Initial trust formation in new organizational relationships. Acad. Manag. Rev. **23**, 473–490 (1998)
23. McKnight, D.H., Choudbury, V., Kacmar, C.: Developing, and validating trust measures for e-commerce: an integrative typology. Inf. Syst. Res. **13**, 334–359 (2002)
24. Khalifa, M., Liu, V.: The state of research on information system satisfaction. J. Inf. Technol. Theoret. Appl. **5**, 37–50 (2004)
25. Khalifa, M., Liu, V.: Determinants of satisfaction at different adoption stages of internet-based services. J. AIS **4**, 206–232 (2003)
26. Khalifa, M., Liu, V.: Satisfaction with internet-based services: the role of expectations, and desires. Int. J. Electron. Commun. **7**, 31–50 (2003)
27. LaTour, S.A., Peat, N.C.: Conceptual and methodological issues in consumer satisfaction research. Adv. Consum. Res. **6**, 431–437 (1979)
28. Mayer, R.C., Davis, J.H., Schoorman, F.D.: An integrative model of organizational trust. Acad. Manag. Rev. **20**, 709–734 (1995)
29. Chiu, C.M., Huang, H.Y., Yen, C.H.: Antecedents of trust in online auctions. Electron. Commer. Res. Appl. **9**, 148–159 (2010)
30. Doney, P., Cannon, J.: An examination of the nature of trust in buyer-seller relationships. J. Mark. **61**, 35–51 (1997)
31. Gefen, D., Straub, D.: The relative importance of perceived ease of use in is adoption: a study of e-commerce adoption. J. Assoc. Inf. Syst. **1**, 1–30 (2000)
32. Chen, C.J., Hung, S.W.: To give or to receive? Factors influencing members' knowledge sharing and community promotion in professional virtual communities. Inf. Manag. **47**, 226–236 (2010)

33. Kankanhalli, A., Tan, B., Wei, K.: Contributing knowledge to electronic knowledge repositories: an empirical investigation. MIS Quart. **29**, 113–143 (2005)
34. Couger, J.D., Higgins, L.F., McIntyre, S.C.: (Un)Structured creativity in information systems organizations. MIS Quart. **17**, 375–397 (1993)
35. Couger, J.D., Dengate, G.: Measurement of creativity of IS products. Creat. Innov. Manag. **5**, 262–272 (1996)
36. Starko, A.J.: Creativity in the Classroom: Schools of Curious Delight. Longman Publishers, White Plains, New York (1995)
37. Fishbein, M., Ajzen, I.: Belief, Attitude, Intention, and Behavior: An Introduction to Theory, and Research. Addison-Wesley Publishing, Mass (1975)

Tackling Barriers to the Inclusion of Disabled People in the European Workplace Through Ergonomics

Louise Moody, Janet Saunders, Natasa Rebernik, Marjan Leber, Andreja Čurin, Marzena Wójcik-Augustyniak and Marek Szajczyk

Abstract The ERGO WORK project is a collaboration of academic and business partners in six European countries. The project is focused on understanding barriers to workplace inclusion, and tackling these barriers through education in ergonomics and universal design and collaboration between academia and business. An exploratory study suggested that workplaces could be further improved in the partner countries to meet the needs of disabled people and there was considerable scope for training within companies to raise awareness about employees' needs, employers' obligations and workplace adaptation. The findings led to the development of new Ergonomics curriculum content in Slovenia and Poland that was implemented in two partner universities. The curriculum was then tested through a series of industry-based projects. The projects formed collaborations between business, employees with disabilities, students and academics and involved adapting the workplace, job design and products to specific employee needs.

L. Moody (✉) · J. Saunders
School of Art and Design, Coventry, UK
e-mail: l.moody@coventry.ac.uk

J. Saunders
e-mail: janet.saunders@coventry.ac.uk

N. Rebernik
OZARA Service and Disability Company Ltd., Maribor, Slovenia
e-mail: natasa.rebernik@ozara.si

M. Leber · A. Čurin
University of Maribor, Maribor, Slovenia
e-mail: marjan.leber@um.si

A. Čurin
e-mail: andreja.curin@um.si

M. Wójcik-Augustyniak · M. Szajczyk
Siedlce University of Natural Sciences and Humanities, Siedlce, Poland
e-mail: marwojaug@tlen.pl

M. Szajczyk
e-mail: marekszajczyk@poczta.onet.pl

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Keywords Workplace design · Inclusive design · Ergonomics · Disability · Ergonomics education

1 Introduction

The inclusion of employees with disabilities in the mainstream workplace is a European priority. Around 80 million Europeans have a disability, representing one in six people in the EU [1]. The European Disability Strategy (2010–2020) strives for a unified approach to inclusion, and to significantly increase the proportion of people with disabilities disabled working in the open labor market [2]. Significant variation exists across Europe in the 'equality gap' [3]. In the UK the implementation of EU Directives is fairly longstanding, yet disabled people are still nearly 4 times as likely to be economically inactive as non-disabled people [4]. In developing countries, 80–90 % of working age people with disabilities are unemployed; in industrialized countries the figure is between 50 and 70 % [5]. As well as the availability of employment opportunities, people with disabilities can be restricted from entry to jobs through the suitability and design of both the workplace and the job itself. An aging workforce will add to the level of impairment and disability to be catered for [6, 7]. Increasing rates of disability and the associated costs mean the application of more innovative and cost effective approaches to ensure the workplace is fit for purpose for a range of needs is increasingly important [8].

Much of the literature in the area focuses on the prevention of disability at work and interventions to prevent and manage injury and encourage return to work [9, 10]. There is a paucity of research exploring European practice in respect to workplace adaptation and the availability of subject specific knowledge in relation to making reasonable adjustments for people with disabilities. Expert reports suggest there is still much scope for improvement [3, 10].

Ergonomists seek to design work to ensure that it fits the needs of the individual [7]. The understanding of ergonomics and human factors, and how it can be applied and translated into workplace practice [11] is variable across Europe. It is argued that here may be a need for improved understanding of how ergonomics can be applied in this context to enhance the employment prospects of people with disabilities and enable companies to be socially responsible and cost-effective.

As a subject, Ergonomics is incorporated in different disciplines to varying extents, from full undergraduate and Master's degree programs in Ergonomics, to smaller modules and assignments in various established disciplines such as engineering, design, psychology etc. However, specialist taught knowledge in relation to disability and workplace adaptation may still be limited and not reach business where it can be applied to support disabled workers. The application of ergonomics in a company setting may require specific, adapted equipment, as well as the skills to discern a specific user's needs and ensure the technology is suitable and acceptable to the user. Managing the change and being open to adaptation, is important—this might involve for example adjusting tasks, access or pace of work

etc. Other disciplines of study, for example Management may benefit from greater inclusion of Ergonomic content, as once at work, graduates are likely to be in a position to influence the inclusion of people with disabilities, and impact work and job design.

The ERGO WORK project is focused on understanding barriers to inclusion, and tackling these through education and collaboration between academia and industry [12, 13]. ERGO WORK—Joining academia and business for new opportunities in creating ERGOnomic WORK places was a 2 year (2013–2015) European project conducted under the Lifelong Learning Programme (Erasmus—Knowledge Alliances). It involved the collaboration of 10 partners across 6 European countries—Poland, Slovenia, the UK, Spain, Italy, and Belgium. It sought to improve the design of jobs and workplaces for people with disabilities by building academic and business partnerships. It focused specifically on developing and testing new teaching material around the inclusive design of jobs and workplaces as well as making adaptations for individual employee needs. This paper provides an overview of the project.

2 Partner Country Analysis

The project was initiated through an analysis in each of the partner countries led by Coventry University. Two research tools were developed; the first was an online survey to assess stakeholder needs, the second an interview schedule to map out curriculum content related to Ergonomics.

2.1 Stakeholder Needs

The online survey explored attitudes to, and needs of workplace inclusion amongst stakeholders and aimed to gain an overview of adaptations to workplaces. The goal was to provide a 'snapshot' of opinions across Europe allowing some cross country comparison.

The survey was distributed throughout the networks of the 10 partners and was completed by 520 participants across the 6 countries. The survey was completed by participants with and without a disability (employees, students, academic staff, managers, CEOs etc.).

Across countries, just under half (49 %) of *all* participants believed that their workplace had been well adapted to employee needs, and a further 28 % felt their workplace was about average. A comparison by country showed that in the UK 69 %, Poland 53 %, Slovenia 51 %, Belgium 39 %, Spain 38 %, and Italy 37 % thought their workplace accommodated disabilities 'fairly well' or 'very well'.

The disabled participants did not feel well-provided for in terms of workplace design. When asked to agree or disagree with the statement 'disabled people are not well accommodated in terms of workplace design', half or more agreed in Belgium, Italy, Slovenia and Spain, while in Poland this figure was lower at 39 % and the UK 36 %.

Participants were asked about the workplace adaptations made for disabled people. They were asked to select adaptations from a list provided. The most common adaptation was physical adaptation to the buildings. Across all countries, adaptations had also been made to jobs and the way they were carried out. By contrast to physical adaptations, the UK participants identified changes to job tasks, role, pace and working hours, less than stakeholders in the other countries. Slovenians were the most likely to identify changes to the job role and hours to suit the needs of disabled people; whilst the Polish participants particularly recognized adaptations to the pace of work.

When asked about adaptations for different kinds of impairment, there was most awareness of adaptations for physical impairment, and low awareness about hearing or visual impairment; with even less knowledge about adaptations for mental health needs and intellectual disabilities.

Although the disabled participants were a very diverse group, we compared their responses as a group to the non-disabled participants. The disabled group as a whole felt less included and was less happy at work than the non-disabled participants.

Across all countries, disabled participants felt that employers needed better knowledge about their obligations and about the possibilities of adapting the workplace.

Disabled participants agreed that the design of the workplace was a barrier to employment opportunities and there are still perceived barriers which prevent them from asking for improvements. Participants were asked 'What barriers exist today for a person with disability to ask for workplace adaptations?'. Disabled participants indicated that the greatest barrier to asking for improvements was fear about job security (over 60 % in all countries) and about being stigmatized or isolated. Lack of knowledge about adaptation possibilities' was chosen most often in Belgium, 60 %, Slovenia, 53 % and UK, 45 %. Perhaps most importantly, relatively few participants selected the option that there were 'no barriers' to asking.

Employers did not seem confident that they held the necessary knowledge to adapt their workplaces with some uncertainty about the legislation regarding adapting workplaces. This was particularly notable in Poland. The survey showed limited awareness amongst participants concerning the ergonomics of work processes and job design, so this area could receive greater focus during the training of experts and employers in particular. The general awareness of the topics of ergonomic design, universal design, inclusive design and accessible design was quite low, so it is clear that steps should be taken to raise this awareness, through the involvement of experts, and training.

2.2 Ergonomics Curricula

An interview schedule was developed to capture the contents of Ergonomics Curricula at sample universities in each partner country. Academics from 17 faculties from 13 higher education institutions (HEI) in 6 EU countries participated in interviews. The sample was limited to the partners and their in country knowledge and awareness, as well as time available.

The analysis was undertaken by the HEI project partners (University of Maribor, Slovenia; Coventry University, UK; Siedlce University, Poland), with additional input from the other countries. Whilst the sample was limited, training in Ergonomics was found to be mostly taught at Masters Degree level. Of the partners included in this project, the UK appeared to have the most mature development of Ergonomics academic training, and provides undergraduate as well as post-graduate dedicated Ergonomics awards. The multi-disciplinary nature of Ergonomics means that related content is included in undergraduate and post-graduate programs in a variety of disciplines in all the countries involved in the study.

When the academics interviewed were asked 'Are the needs of PWD (persons with a disability) taught?' in the curriculum, the dedicated Ergonomics programs were able to answer 'Yes', as also were some specific components such as 'MSc in Assistive Technology' (Coventry, in Health & Life Sciences Faculty); 'Disability, ageing and inclusive design' (Loughborough, part of Design Ergonomics); and Special Education Pedagogy components (Koper), but for the less dedicated taught curriculum components, the answer was more likely to be 'Partly' or 'No'. The focus on 'Inclusive Design', in Slovenia and Poland was found to be limited, with a tendency to focus on medical models of disability. The specific focus on users with disabilities or the workplace is absent, unless students carry out detailed project work in this area.

3 Development of the Curriculum Content

It was concluded from this first phase of work that there was a need to improve understanding, knowledge and skills in the adaptation of workplaces and work to individual employee need, particular in Slovenia and Poland. In particular the need to raise awareness of and empathy with the varied needs of employees—rather than placing focus on specific 'groups' and their needs was needed. It was identified that there was a need to further develop training and a list of recommendations for developing or improving the curriculum content were made:

- Teach from a perspective of 'inclusive design' or 'universal design' so that methods can be applied across different contexts and scenarios.
- Ensure all students gain some depth of knowledge, not only those students choosing projects related to disability
- Teach empathic skills through the use of empathic equipment, case studies and person as

- Teaching should include some interaction with real users as part of every students' training, including 'older people'—this is an essential part of good practise in inclusive design and occupational therapy teaching
- Include more knowledge about mental health needs in the workplace, in particular in relation to job design and interventions.
- Place a focus on linking workplace interventions to employee needs—currently most Ergonomics training in relation to the workplace tends to focus on prevention of harm, increasing efficiency etc. A focus on increasing opportunity and enabling disabled employees to carry out jobs in mainstream employment is recommended.
- Explore curricula and include knowledge from organisational behaviour and occupational psychology to support the implementation of workplace interventions
- Share knowledge about tools for inclusive design. These include physical tools such as empathy simulators, and software tools such as hearing and vision simulator software, specialised building design software and specialised ergonomics anthropometry analysis.
- Consider including knowledge and case studies about assistive technology and accessible environments.
- Consider ultimately seeking accreditation from European Ergonomist (CREE) for any specialised content that is developed

In response to the above recommendations, the contents of teaching modules were developed through collaboration between the three HEI involved in the project. 5 different modules were initially planned covering different types of disabilities and universal design. After advice from Coventry University, the five modules were merged to move away from a medical model of disability; and towards a broader understanding of Universal or Inclusive Design. The content was designed to support the existing study programmes of different disciplines with the Slovenian and Polish Universities and therefore available in 3 languages. The resulting material includes modules and teaching resources and workshops on:

1. Work Study and Ergonomics—Understanding the workplace and job
2. Understanding individual employees and their needs
3. Ergonomics in Business—Understanding the job and business needs
4. Inclusive Design
5. Mobility and accessibility

4 Pilot Projects

Having designed the curriculum, the material was delivered and tested through a series of pilot projects with businesses in Slovenia and Poland. The aim was for students, and academics to work collaboratively over a 6 month period with

businesses facing real challenges in creating workplaces adapted to disabled employee need.

The Slovenian and Polish partners carried out several meetings and creative workshops with the potential companies for collaboration to identify suitable workplaces in which the curriculum knowledge could be tested and applied. As a result 4 multidisciplinary groups were formed of 6 students alongside 3–4 experts coming from academia and business (2 groups in Slovenia, 2 groups in Poland). 6 pilot projects were implemented. The projects are summarised below in Table 1 with illustrative workplace images in Fig. 1.

2 pilot projects were undertaken in Slovenia and 4 in Poland; they represented a range of different workplaces and individual needs for the groups to analysis, design and make recommendations for.

Through the pilot projects a number of recommendations for improvements in workplace design and layout were suggested. After completion and evaluation of the pilot projects, the curriculum and the contents were finalised and mechanisms to ensure their sustainability in the Polish and Slovenian partner universities continue to be explored. The ergonomics based content may be a useful addition to programs in engineering, design, occupational health or business.

The projects led to a number of benefits for those involved. The students involved gained experience in collaboration with business, gaining new knowledge

Table 1 Summary of projects undertake to test the curriculum in Slovenia and Poland

Country	Collaborating company	Company specialism
Slovenia	OZARA & BUČAR	Carpentry workshops
Motion analysis of work associated with pallet production by 2 disabled employees. Adaptation of an office work station of a non-disabled employee at risk of back injures (a sitting-standing work station employed)		
Slovenia	Bodočnost Maribor d.o.o.	Assembly-production line of cosmetic products
Ergonomic analysis of the work places, work processes and company premises was undertaken and improvements proposed at a company focused on the rehabilitation and employment of disabled people. The accessibility of the premises was considered for different groups. Satisfaction at work analysed		
Poland	Łuksja Sp. z o.o.	Factory producing ladies clothes
Review of the activity of using the multi-ply spreading and cutting machine and proposal of improvements for ease of use. 70 % of the workforce have a disability		
Poland	Medical & Diagnostic Center Ltd.	Medical Centre
Work place was analysed and re-organised to better fit the needs of a call centre operator with a disability		
Poland	Asaj.	Network of electrical installation and lighting stores
Analysed the workplace with proposed solutions for a sales manager with disability.		
Poland	UDT,	Office of technical inspection
Analysed the workplace with proposed solutions for an employee of the Administration Department		



Fig. 1 Pilot project workplaces in Slovenia and Poland

about ergonomics, inclusion and business demands. They gained empathy with the employees they were working with. Employees with disabilities were involved in co-designing solutions for their working environment, as well as gaining an understanding of ergonomic principles. The academics involved benefitted from the knowledge exchange with business as well as the development of core teaching content. The business partners benefitted from improvements to their working environments and new knowledge about ergonomics and inclusive design.

5 e-Platform

The project led to the development of the ERGO WORK e-platform [12]. The online resource provides a knowledge hub and seeks to build a community of interested stakeholders from the academic and business perspective. The e-platform includes embedded social media news, and provides a platform for businesses to share experiences, knowledge and good practices within the field of Ergonomics and Universal design. It provides project results as well as a body of ergonomics literature and links, and low cost universal design solutions.

6 Conclusions

The ERGO WORK collaboration brought together business and academic partners to improve workplaces for employees with disabilities. Over the 2 year project specialized teaching content was developed and piloted. An ongoing dissemination campaign continues especially amongst companies to promote knowledge exchange in the field of ergonomics and universal design and application in the context of adapting workplaces to the needs of people with disabilities. Recommendations generated during the project have been distributed to 800 relevant system and policy

making institutions, authorities, chamber of commerce and relevant associations and networks in the 6 partner countries.

The project has begun to address the paucity of research in relation to European differences in stakeholder needs and the practices and application of ergonomics in the development of accessible workplaces. The ERGO WORK collaboration continues to encourage cooperation between universities, businesses and other organizations to improve learning, teaching and knowledge transfer in respect to ergonomic workplace design for disabled employees. It is hoped that education and training will lead to the improved job design and workplaces; but also empower employers with the knowledge, skills and confidence to enhance the employment prospects, and working environments of disabled people.

References

1. European Commission (EC): European Disability Strategy. http://ec.europa.eu/justice/discrimination/disabilities/disability-strategy/index_en.htm (2013). Accessed 8 Dec 2014
2. European Disability Strategy 2010–2020 Guide. (http://www.eubusiness.com/topics/social/disability-2010-20/) (2014). Accessed 11 Dec 2014
3. Priestley, M.: 'Targeting and mainstreaming disability in the context of EU2020 and the Annual Growth Survey', Synthesis report prepared for the Academic Network of European Disability experts (ANED). University of Leeds, Centre for Disability Studies, UK (2012)
4. Papworth Trust 'Disability in the United Kingdom, 2014, Facts and Figures'. www.papworthtrust.org.uk. Accessed 7 Jan 2015
5. UN Enable—Disability and Employment. http://www.un.org/disabilities/default.asp?id=255. accessed 25 Jan 2014
6. Shrey, D.E., Hursch, N.C.: Workplace disability management: international trends and perspectives. J. Occup. Rehabil. **9**(1), 45–59 (1999)
7. Stubbs, D.A.: Ergonomics and occupational medicine: future challenges. Occup. Med. **50**(4), 277–282 (2000)
8. Amick, B.C., Habeck, R.V., Hunt, A., Fossel, A.H., Chapin, A., Keller, R.B., Katz, J.N.: Measuring the impact of organizational behaviours on the work disability prevention and management. J. Occup. Rehabil. **10**(1), 21–38 (2000)
9. Franche, R.-L., Baril, R., Shaw, W., Nicholas, M.: Loisel workplace-based return-to-work interventions: optimizing the role of stakeholders in implementation and research. J. Occup. Rehabil. **15**(4), 525–542 (2005)
10. Greve, B.: 'The labour market situation of disabled people in European countries and implementation of employment policies: a summary of evidence from country reports and research studies'. Report prepared for the Academic Network of European Disability experts (ANED). University of Leeds, Centre for Disability Studies, UK (2009)
11. Caple, D.C.: The IEA contribution to the transition of Ergonomics from research to practice. Appl. Ergon. **41**(6), 731–737 (2010)
12. ERGO WORK. http://www.ergo-work.eu. Accessed 3 Dec 2014
13. Saunders, J., Moody, L.: ERGO WORK: European perceptions of workplace inclusion and application of Ergonomics. In: Sharples, S., Shorrock, S., Waterson, P. (eds.) Contemporary Ergonomics and Human Factors 2015. Taylor& Francis, London (2015)

Survey of Strategic Design for Public Transportation

Ashkan Bayat

Abstract After completion, inter-city railway, with its own characteristics, will fuel a new around urban development of surrounding area. Under the guidance of core development Theory of TOD, systematic construction of railway stations surrounding area is needed to be done from four aspects: resource characteristics, overall positioning, function layout and development intensity; meanwhile, with the consideration of social and economic benefits government and construction enterprises need to optimize the management of railway stations surrounding area at the early stage of project and operate scientifically by using the market mechanism. This paper, taking the Heshengqiao railway between Wuhun city and Xianning city as an example, proposes suggestions for land use strategy of inter-city-railway station surrounding area, with a view to optimizing resource allocation, raising the status of the railway stations surrounding area, facilitating the optimization of city space and improving the competitiveness of the city.

Keywords Inter-city railway · Traffic station · Land use strategy

1 Research Background

1.1 Characteristics of Intercity Railway

While the rapid development of china s urban economy and the expansion of urban agglomeration. The pressure on urban transport is becoming increasingly acute. fast and convenient intercity railway with large carrying capacity accordingly, becomes

A. Bayat (✉)
Urban Planning, Islamic Azad University of Najafabad, Najafabad, Isfahan, Iran
e-mail: Ashkan_bayat2001@ymail.com

A. Bayat
Transportation and Traffic of District 11, District 11 of Tehran Municipality, Tehran, Iran

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an important approach to strengthen the interrelation among urban agglomeration and ease population pressure in key cities. Different from major railway line, intercity railway are specially designed to provide regional high-speed rail service for cities and town in a economic zone or a metropolitan area and focuses on intercity and inner city traffic, on one hand, they aim at different passengers and different goals; on the other hand, they are closely connected and well supplement each other. Consequently, intercity railway transport can be defined as a convenient and fast public rail traffic system with large carrying capacity and reasonable connection with inner city traffic for passenger transport between large cities, central cities and satellite cites within well-development and densely–populated metropolitan area.

However, just like urban rail transit (metro), despite good social benefit, intercity railway also face such problem like large initial investment, high operating cost and poor economic benefit. Therefore, it was emphasized in the document entitled Notification on strengthening the construction and Management of Urban Rapid Rail Transit. That we should well control and make special plan for land use along the railway to prevent the illegal appropriation of railway tracks by new buildings. The lack of reasonable planning and control for these lands will severely impair the economic benefit of railway, hindering urban development and destroying urban spatial layout; in the long-term the intercity railway might become "financial burden" of the government. Therefore, we must conduct an integrated and comprehensive study on intercity railway and the control of land use in the areas along the railway.

1.2 Relationship Between Construction of Intercity Railway and Development of Lands Around the Station

The Relationship between Intercity Rail Transit and Land Price. One of the most striking characteristics that distinguish urban land from other production factors is the different ground rent caused by different relative location. As a result, two important theories come into being: the bit rent Theory and the location Theory. The essence of the relationship between urban transportation and land use lies in the complementation between transportation cost and rent. The lands closer to the center of city have higher and price due to lower transportation cost. He Ning et al. believed that there was a certain degree of substitutability between land price and transportation facility [1].

The improvement of transportation means the increase of travelling speed and the reduction of transportation fee; for example, rail transit improves the travelling means speed of residents, decreases travelling time and reduces opportunity cost. The land rent is in inverse proportion to the distance from the center of the city; besides, the sum of the land rent and transportation cost is a constant. The vanishing point of land rent represents the boundary of the city; when the transportation facility is improved, the transport cost will be reduced, the land price will be

improved correspondingly, and the vanishing point of land rent will move far away from city center. This phenomenon shows of urban construction cities can rely on intercity railway, a rapid means of transportation with large carrying capacity between cities, to from corridor spatial layout, in which the surrounding areas of station will be the polarized spots receiving priority in development.

Intercity Rail Transit Promoting Land Development. The different in means of transportation is closely related to land use. The construction of intercity railway can improve competitiveness of the economic development with surrounding cities [2]. It is also conductive to regional integration. With large carrying and frequent running with short-time interval like bus, the intercity railway provides highly efficient and convenient services, timely transporting passenger flows, improving the accessibility of area along the railway redistributing the crowed in downtown areas, and thus upgrading urban structure. It is also conductive to easing pressure on overly congested and concentrated central cities and forming various axial zones which are geographically separated but well connected with rapid transport means. With multiple axial zones. We can from a multi-center development mode with regional central city, sub central city and medium and small towns along the railway (Fig. 1).

On the other hand, intercity railway provides us a rapid means of transportation to get in and out of central cities, so that residence and employment can be separated geographically to some extent, which means that people can choose to work in cities while in outskirts. With more people residing, the commercial and public service facilities around the station will aggregate rapidly and quantity of demand would pick up [3].

This shows that the construction of intercity railway has huge impact on the using properties and development intercity of the lands around station along the railway. In some sense, the planning of land use around the railway station and construction of intercity railway are supplementing and promoting each other. A good land use planning can bring passenger flow to intercity railway, while the

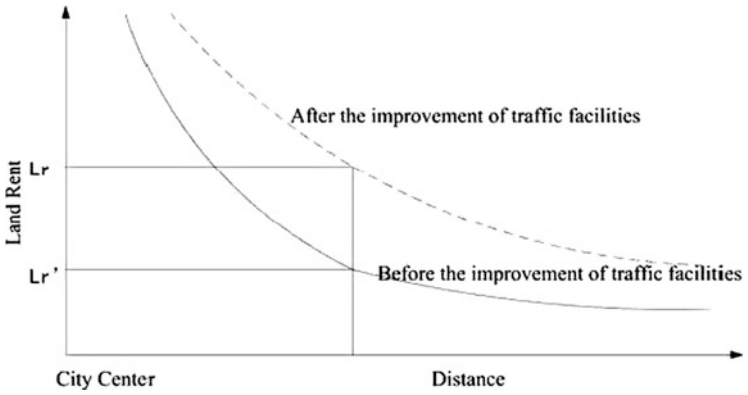


Fig. 1 Curve of land rent after the improvement of traffic condition

construction of inter city railway can provide reasonable guidance for the properties of land use the reassignment of construction density and from a good urban spatial structure and land layout.

1.3 An Overview of the Intercity Railway from Wuhan to Xianning

Wuhan–Xianning intercity Railway, commonly abbreviated as Wu–Xian Intercity Railway lies in the south of Hubei Province, connecting Wuham to the north, which is known as a thoroughfare leading to nine provinces, and Xianning to the south, a famous eco-city in the south of Hubei from Wuchang Railway station (railway hub in Wuhan), passes Donghu New & High Technology Development Zone, Miaoshan Economic Development Zone and Zifang Town in jiangxia District, and enters the territory of Xianyang at Hesheng. The railway line is 90.12 km long currently, with a reservation line to extend to Changsha. The total passenger flow is expected to reach 81,400 and 153,500 person-time in 2020 and 2030 respectively. There are altogether 11 station throughout the entire railway, i.e. Tangxunhu, Miaoshan, Pu an, Zhifang East, Wulongquan East, Tuding East, Dongpo East, Heshenqiao East, Xianning East and Xianning South, see Fig. 2. The average station spacing is 7 km and the longest station spacing is between Wuchang Station and Tangxunhu Station, 17.7 km. The highest speed attainable is 190 km/h and it takes 28.5 min to cover the whole distance.

On December, 28, 2013 the intercity railway from Wuhan to Xianning was officially put into use. In order to take full advantage of intercity railway to fuel economic growth, government along the railway station set up specialized policies according to local industrial advantages and location conditions.

2 Research on the Construction of Land Function Around Intercity Railway Station

2.1 The Sphere Theory Based on TOD Mode

The functions of lands around railway stations vary greatly depending on their distance from the station Pol et al. [4] proposed the “Three Spheres” structural mode based on the previous examples of development surrounding areas of railway stations [4] (Table 1).

The first sphere is the core area, which is 0.5–0.8 km from the station, covering an area of 1–1.5 km^2. It is the area with strongest direct association with the railway

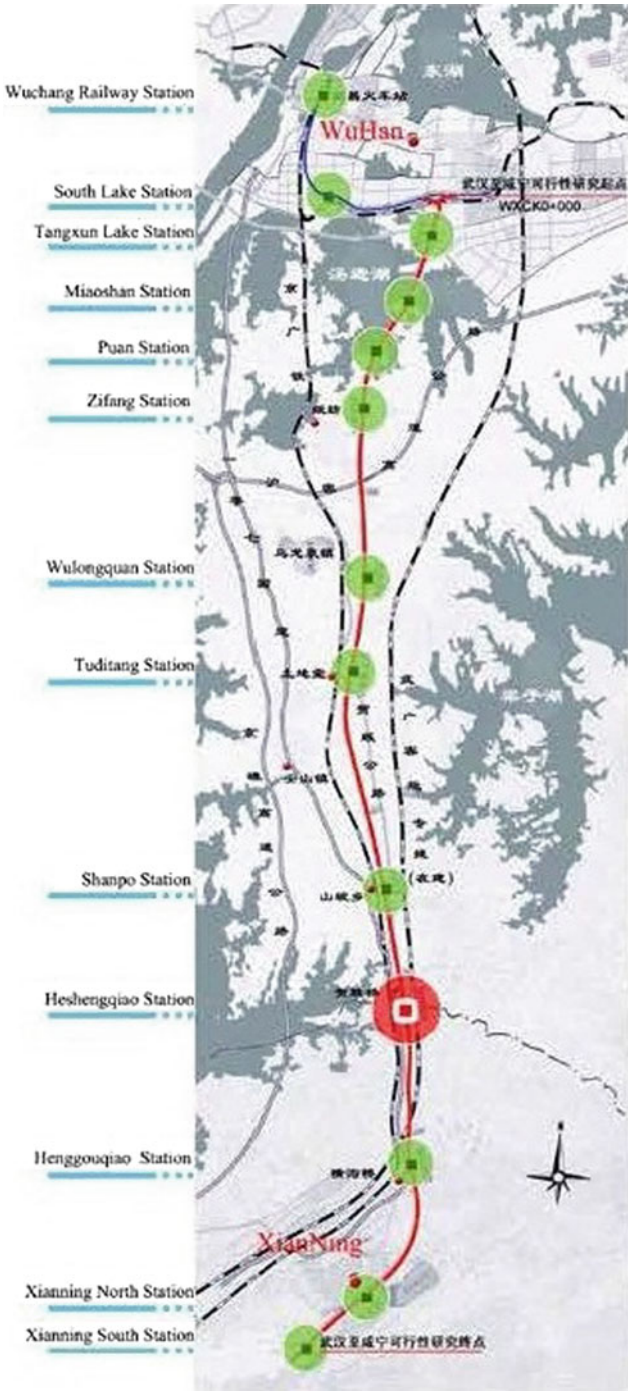


Fig. 2 Sketch map of intercity railway from Wuhan to Xianning

Table 1 The basic features of each sphere

Level	First sphere	Second sphere	Third sphere
Distance from the station	0.5–0.8	0.8–1.5	>1.5
Effect	Transportation service area	Promote the region directly	Catalyze the region indirectly
Vitality	Very strong	Strong	Marginal effect
Influence on spatial arrangement	Direct control	Direct impact	No direct association
Impact behaviors	Road. Land Layout, function, land price	Function, population, real estate	Urban function
Boundary	Clear boundary between adjacent blocks	Weakened boundaries in the surrounding neighborhood	No direct reflection on land function, with blur boundary
Highly associated function	Catering, hotel, business, office, information industry, tourism center	Business office, information, residence	Urban function

station, where industrial serving station directly and some other related businesses are concentrated. This area includes station yard, main body of hub, square accessory occupancy, bus station, urban rail transit station and comprehensive means of transportation, and service industrial like large-scale business, hotel, business office, finance, exhibition and entertainment industry. The development intercity is high within this area. This area plays the most basic function of the station, and can be taken as the "outward oriented" area complementing the development of station.

The second sphere extends and supplements various function of the first sphere, which is 0.8–1.5 km from the station. With an area of 3–5 km. The association between this area and rapid transit railway station is relatively weakened. The major industries aggregated in the area are cultural industry, high-technology industry and lands for logistics industry and other business offices. The functional orientation of this area shifts from passengers to residents. various functional of the city have also transformed from "outward oriented" to "inward oriented". The development intercity of this area is relatively high.

The third sphere is the periphery area, the function of which is somewhat related with the operation of rapid transit railway, but the dependence is not that high. The association between this area and rapid transit railway and station is more weakened. While the development intensity depends on the land property and development goal, which is determined by a number of factors like the goal of urban development or localization of the area.

2.2 Localization of the Area Around Heshengqiao Station

Located in the north of Xian an District in Xianning city, Heshengqiao Town adjoining neighbor of Jiangxia district in Wuhan city lies on the border of two cities. Five north-south traffic lines transverse through it, i.e. National Highway 107, Beijing–Hong Kong–Macao Expressway, Guangzhou–Wuhan highspeed railway, Beijing–Guangzhou Railway and Wuhan–Xianning intercity railway. Heshengqiao Town is at the north of Xian District in Xianning city, but still belongs in the radiation range of Wuhan. it is an important station in the intercity railway of Wuhan metropolitan circle, as well as the north gate of Xianning, with vast back—land and abundant natural resources. With the opening of the intercity railway from Wuhan to Xianning and in order to implement the development idea of "one station one city", the overall planning of Xianning city selected Heshengqiao as one of three new towns in Xianinng in the future and named it Zishanhu (hesheng). New Town which was defined as the satellite town of the intercity railway station with Wuhan metropolitan circle and the waterfront high-tech and eco-friendly new town suitable for living and traveling.

According to the actual situation of new town and the upper level planning, the function of the surrounding area of the station is defined as the modernized urban area intercity railway station as the core and integration commerce and trade, residence, transportation service and culture recreation [5]. The area adopt TOD land layout, which has intercity railway station as the center surrounding by functional areas such as business office, hotel and tourism. Residential land is planned in the periphery sphere. The entire surrounding area of the station is constructed as the starting point of new town development and in the future the construction will spread toward the Whole new town.

3 Development Intensity and Layout of Land Use

3.1 Development Intensity

The development intensity of the surrounding areas of rail transit station both at home and abroad are very high and floor area ratio varies from 5 to 11. Even the city at lowest level in japan has a floor area ratio of 5–8 in the city center; the floor area ratio of the area around station is approximately 2 in the region of Jiangsu and Zhejiang in China, 3–4 in the coastal regions in Guangzhou; the commercial floor area ratio around rail transit station in new town in Hong Kong is 3 and the residential floor area ratio is 2–8; the floor area ratio in the high intensity area of

Table 2 The relationship between the diversification of functional grouping and development intensity of foreign stations

Region	Project	Function	Floor area ratio	Floor area
Washington	International Plaza	Business, office, service	11.39	0.99
Ikebukuro	Metro Plaza	Department store, art gallery, restaurant, office	10.74	6.1
Montreal	Bonaventure Plaza	Hotel, office, exhibition, business	4.77	2.1
Toronto	ArkHills	Hotel, exhibition, business office, retail	4.77	5.6
Machida	Area in front of the station	Department store, catering, retail	4.77	2.1

Hongzhou East railway is 2.5 and 1.5 in the low intensity area; jintang station in Zhuhai has a floor area ratio of 4.8 and 3.3 in high intensity area and low intensity area respectively (Table 2).

The development intensity control of the areas in from of Heshengqiao station that coordinates benefit and environment protection.

Heshengqiao station, located in the north of Xianning and adjacent to Zishanhu in the east, and is an ecological new town with appealing sceneries of hills and waters. The overall development intensity of the new town therefore must meet the requirement of eco-environment protection. While the area in front of the station must also reach circumstances with function layout and sphere control, the development intensity of the business district in front of the station is relatively high and controlled at 2.0–2.5, forming compact spatial layout. Such layout intends to efficiently utilize the area in front of the station, so as to establish business service area and create image and gateway space. The development intensity of the residential and service facilities in the outer sphere is diminished moderately and controlled at 1.0–2, so as to create a good living environment. Such planning is also conductive to integrating the natural ecological green lands of the periphery into the front of the station to improve greening system (Fig. 3).

3.2 Suggestions for Development Intensity and Proportioning of Function

Through studying the development intensity around relevant rail transit, the author suggests the total land area shall be taken into consideration when development the surrounding areas of intercity railway and the reasonable floor area ratio should be



Fig. 3 The development intensity of lands in the area around Heshengqiao station

2–4. In addition, the floor area ration can be reduced by developing certain amount of underground spaces [6].

With reference to the development to the abovementioned cases, in the functional area of business and office, residential building and public building are half and half; while in the functional area of living, residential building generally account for 80 % of the land. The following table lists the proportioning of specific functional in the development process (Table 3).

Table 3 Suggestion for the dominant function and proportion of development in the surrounding area of intercity railway station (%)

Dominant function	Residence	Business	Office building	Hotel	Recreation and others
Commercial	50–60	10–20	15–25	5–10	5–15
Residence	80–85	5–10	0–10	0–5	5–10

4 Planning Management and Implementation Strategy

4.1 Mode of Operation

The development mode should combine intercity railway construction and property development, The development mode with government leadership and market participation will be the major mode of operation for intercity railway in the future. For example, we can establish joint venture company (combining state-owned capital) to take full charge of the promotion, international cooperation, land control, operation and management of the project and some relatively independent development in the planning, such as the construction of infrastructure and public service facilities. The rest can be left to the market to allow market behavior to conduct the development and construction of secondary market.

4.2 Development Strategy

The Timing of Housing Demolition and Relocation and Development.
(1) *Consider on the Whole and Implement Step by Step.* The construction of intercity railway is a long process, which starts from housing demolition and relocation investment promotion, to development and construction and finally putting into use. The whole process may last for 3 or 5 years at least. Sometimes tens and even more years. Therefore, we need to take the long view, consider on the whole and implement step by step. Department concerned should work together and cooperate with each other, take an active part in construction of public government service platform and form the mechanism in which specialized company is responsible for operation and development under the guidance of the government [7]. We should make one overall planning and develop step by step on term basis.

(2) *Take Good Control and Make Reservation and Choose Ideal Time for Development.* If the timing is premature for development in the near future, we had better take good control and make reservation, rather than haste for success at the cost of development quality and standard because we should have confidence that with improvement of economic situation and facilities like rail rail transit, the development prospect rosy in the future; however, one we have conducted development with low quality, it would be very difficult to make amends in the future.

Actively Improve Development Conditions and Scientific Operation Mechanism. According to relevant domestic and foreign experiences, the improvement of infrastructure and other condition in the surrounding area of intercity railway station can effectively promote the value of land in the planned area and is very good for attracting strong developer. Consequently, the government should vigorously improve the development conditions within the planned area, including opening *BRT* route and create a good investment environment. The author suggests the scientific operation mechanism shall be introduced and government of different areas shall

gather together to make decisions, clearly distinguish the relationship of rights, responsibilities and interests among various parts in the development process of the station area and leave the concrete implementation to company in charge of the development, introduce professionals to take full charge of the planning, development, construction and investment attraction of the project, cooperate and cording among various parties and jointly promote the implementation of the project.

Strictly Control the Quality of the Development and Modify the Content of Development without Delay. The area around intercity railway station is the gateway of the city to the outside. The quality of the development within the area will directly influence the image of the city; therefore, the author suggests that the quality development should be controlled effectively while improving the development conditions in the planned area. In particular, the key areas should be development by developers with powerful strength, so as to ensure the quality of development. Appropriate plan positioning and overall design should be made to guarantee the high standard and good quality of the development project; the focus should be the control of the road network and area gateway image [8].

We should strengthen planning control and conduct land use and project approval in strict accordance with the requirements in the planning; a detailed land supply plan be formulated in advance; as for the project resulting in long time idle land due to failure to develop in accordance with the project schedule, the lands should be recovered to rules.

5 Conclusions

Due to its characteristics, intercity railway surely will make the areas around its station the key areas in the next round of urban development after its completion. Guided by "*TOD*" core idea of development, the land use in the areas the station should combine with the characteristic of the lands. The function layout should be reasonably.

Meanwhile, the government and construction enterprises should take full account of social benefit and economic benefit. They should conduct optimization on the area around the station in the preliminary stage of the project and apply market mechanism for scientific operation, so as to guarantee the scientific, reasonable, economic and efficient use of lands around intercity railway station.

References

1. He, N.: Analysis of planning system of urban rapid rail transit. Doctoral Dissertation to Tongij university (1996)
2. Hung, J.Z.: Research on the mode of urban land development and passenger transport in Chinese mega-cities. Doctoral Dissertation of Tongij urban (2003)
3. Urban Land Institute: Joint Development: Making the Real Estate—Transit Connection. China Building Industry Press, Beijing (2003)

4. Pol, M.J.: The economic impact of the high-speed train on urban regions Austria: European regional science association (2002)
5. Wang, T., Lu, J.W.: Railway station complex and urban catalyst—example of shanghai south railway station. Urban Plann Form **4**, 76–83 (2006)
6. Zheng, W.H.: Discussion on land use intensity about different type of rail transit station area. Urban Stud. SI, 93–95 (2008)
7. Geng, M.Y.: A Probe into the financing mode of urban rail transit projects in china. Urban Public Transp. **8**, 24 (2005)
8. Xiao, H.Q.: A research of joint development in URT station districts. Urban Mass Transit. **2**, 6–9 (2008)

Part XVI
eLearning and Teaching Strategies

Language e-Learning and Music Appreciation

Leon Chong Wen Ngiam and Swee Lan See

Abstract Globalisation and the rise in mobile technology led to the rise of language e-learning for leisure and work purposes. However, current language apps in the market often lack adaptation to relevant gamification and pedagogies for learners with integrative and instrumental motivation. Consequently, learners lose interest as the apps fail to engage them and fulfill their learning objectives. Moreover, the appreciation of the underlying cultures in music appreciation has not been fully understood. It was discovered that music and language have neurological links, and when introduced simultaneously, benefits both language and music education. Sadly, the lack of music appreciation and language abilities could be attributed to social stratification. Possession of such cultural capital can exacerbate social inequality by causing the Matthew effect, triggering the poverty trap. Therefore, we propose the 'Polyglotism' prototype to devise a more effective e-learning strategy and mitigate social inequality through free access to language and music education.

Keywords Language learning · E-Learning · education · Cultural capital · Learning sciences · Language pedagogy · Learning strategy · Mobile learning · Accelerated learning · Gamification · Music appreciation · Crowdsourcing

1 Introduction

The desire and need to learn foreign languages arises with globalisation. Of the employers interviewed, half desired their prospective employees to be fluent in a foreign language [1]. Globally, there are 1.2 billion language learners [2]. Globalisation of pop culture increased the demand for language learning and

L.C.W. Ngiam (✉) · S.L. See
Institute for Infocomm Research (I2R), A*STAR, 1 Fusionopolis Way,
Singapore 138632, Singapore
e-mail: leon29yan@gmail.com

S.L. See
e-mail: slsee@i2r.a-star.edu.sg

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witnessed a 45 % rise in Korean class enrolments in 4 years as the K-Wave permeates cultures [3]. Hence, language learning has become more pertinent.

Over the years, due to a fixation on pop music, poor music pedagogy in schools and sociocultural reasons, fewer people appreciate highbrow music. In 2013, only a mere 2.8 % of classical albums were sold worldwide [4]. This paper explores some reasons ascribed to the decline in highbrow music and provides some ways to promote classical music.

Mobile learning is a process where knowledge is acquired through multiple contexts from people and personal interactive technology [5]. In America, 64 % of adults own a smartphone and 30 % used their phones to obtain educational contents [6]. Therefore, there exists a huge potential to enhance music appreciation and learn languages through e-learning.

2 Language Learning

Language *acquisition* refers to the subconscious learning of the language without knowing the formal grammatical rules, while *learning* refers to the conscious knowledge of the language in formal instructions. Krashen posits that the Affective Filter Hypothesis affects Second Language Acquisition (SLA) and is itself affected by motivation, anxiety and attitude [7].

2.1 Language Learners

Language learners are categorized into 2 groups—those with an integrative and an instrumental motivation [7].

The integrative learner has an objective to assimilate into the community by *acquiring* mastery in the communicative aspect. Emphasis is placed on understanding the underlying cultures in the target language (L2) to enhance communicative learning. Such a learner has high motivation, low anxiety and a good attitude, which lowers affective filter to allow input to access the Language Acquisition Device (LAD) easily and be *acquired* [7]. This results in long-term success in SLA [8]. However, the lack of error correction results in a weaker foundation that hinders the development of advanced linguistics concepts.

On the other hand, the instrumental learner wishes to widen their career prospects through linguistic abilities and they *learn* the language. Emphasis is placed on reading and writing to prepare for standardized testing. Ergo, this results in higher affective filter due to test anxiety, low motivation and relatively poor attitude, hindering input from reaching the LAD [7], which results in less long term success in SLA [8].

Instrumental motivation is crucial in attaining intermediate language proficiency, but integrative motivation is essential to *surpass* this level [9]. Thus, cultivating integrative motivation should be prioritized. Introducing the culture of the language to learners can increase the motivation levels. This happens as students get to concretize classroom knowledge and gain a deeper connection to the language culture. Even those who were initially instrumentally motivated can become integratively motivated when they develop a liking for the culture. In fact, both instrumental and integrative motivations are used together to assist successful SLA [8].

2.2 Communicative Approach (CA)

CA was developed with the notion that language primarily serves as a system for communication. Emphasis is placed on speaking, listening, reading and writing, at a level adequate to communicate ideas as seen in Table 1. Complex grammar rules should be excluded unless the student is keen and teacher is capable of delivering comprehensible input. Upon developing Communicative Competence, learners advance to Communicative Performance—realizing the competencies in Table 1. in the real production and comprehension of utterance [10]. They can be developed through social activities without much error correction. Thus, CA has low affective filters due to higher integrative motivation, better attitude and less anxiety. However, the lack of early error correction leads to the formation of bad habits that might hinder further development.

Polyglotism will be designed on the parameters of the CA to tap on the benefits of lowered affective filter and comprehensible input. However, when learners lack grammatical competency, it reduces integrative motivation due to the difficulty encountered [12]. Thus, a combination of compulsory and optional grammar explanations will be provided in the app to support instrumental and integrative learners.

Table 1 Aspects of communicative competency [11]

<table>
<tr><td colspan="4">Communicative competence</td></tr>
<tr><td>Grammatical competence</td><td colspan="2">Sociolinguistic competence</td><td>Strategic competence</td></tr>
<tr><td rowspan="2">Knowledge of lexical items and of rules of morphology, syntax, sentence—grammar semantics, and phonology</td><td>Sociocultural Competence</td><td>Discourse Competence</td><td rowspan="2">Verbal and non-verbal communication strategies</td></tr>
<tr><td>Knowledge of the relation of language use to its non-linguistic context</td><td>Knowledge of rules governing cohesion and coherence</td></tr>
</table>

Table 2 Comparison of four pedagogies

	Grammar-Translation (GTA)	Cognitive (COG.)	Cognitive Academic Language Learning* (CALLA)	Suggestopedia
Focus of approach	Reading and writing	Master all aspects of language	Developing academic language	Accelerated learning
Pedagogy	• Early reading of difficult classical texts • Translating sentences from native language to L2 • Grammar drills	• Individualised instructions • Errors is inevitable and constructively used in learning • Language learnt consciously and deliberately	• Intermediate students attend academic lectures to learn content-specific vocabulary through different subject matters [13]	• Baroque music is played to relax students • Teacher read and perform dialogue with emotional intonation [14]
Pros	• High grammar competency	• Strong foundation is built; further development can continue	• Develops Common Underlying Proficiency • Exposure to language discourse	• Low affective filter • Taps on reserve capacity of brain • 5 times faster and deeper learning [15]
Cons	• Oral-aural skills are neglected • Boring	• Highly time consuming	• Discriminates beginners	• Music may be distracting

2.3 Other Language Pedagogies

The review of pedagogical literatures yields the comparison between four language pedagogies in Table 2. From the literature, it seems that the Communicative Approach combined with elements of other pedagogies is most suitable to the purpose, needs and receptivity of today's language learners. Thus, the pedagogies in Table 2. will be adapted in the app activities along with the Communicative Approach.

3 Current Language Applications

Current language apps rarely have interaction with native speakers, an adaptive feedback system and a community of language learners to support each other [16]. Most apps only seek to develop a linguistic foundation for the learners but do not

Table 3 Comparison of two language learning apps

	Duolingo	iTalki
Cost	Entirely free	Expensive
Revenue	Crowdsourcing	Sales of virtual credits
Popularity	100 million users (2015)	1.5 million users (2015)
Activities (Bracket shows type of pedagogies used)	• Sentence translation (GTA) • Pronunciation drills (Audiolingual) • Vocabulary drills (CA) • Constructing sentences from discrete lexicon (COG.)	• Online tutoring by language tutor (COG.) • Language partners (CA) • Publication of langauge related material by users and read by learners (reading approach) • Learners write in L2 and assessed by native speakers (COG.)
Pros	• Has a social objective • Entirely free due to crowdsourcing • Adapts to Common European Framework of Reference for Languages (CEFR)	• Professional help available • Accelerated learning through 1–1 sessions • Adapts to the CEFR
Cons	• Limited communicative competency development • Lacks detailed grammatical explanations • Boring audiolingual drilling reduces motivation • No individualised feedback	• Expensive as tutor is paid per hour • Discriminates beginners who need language programs (like Duolingo) to develop foundation during the silent period

allow learners to learn practical advanced materials. Consequently, learners' developmental needs are not fulfilled. Table 3 compares two popular language apps. Duolingo caters to mainly beginners and intermediates to develop foundation while iTalki seeks to provide formal instructions for learners to advance their language studies.

Current language applications adopt Pointification to provide extrinsic motivation to improve performance but failed, as the scoring system is not integrated into the underlying activity [17]. Consequently, the users' interests are only sustained in the short run.

4 Links Between Second Language Acquisition and Music

Music facilitates incidental vocabulary acquisition and can be enhanced by extralinguistic support like illustrations and tones. In fact, audio stimuli show better memory superiority than visual stimuli, especially for temporal anaphora. This is due to the prosodic features of oral language, which facilitates storage, and retrieval of suprasegmental units. In fact, dual modality stimuli (audio and visual) are better

than single modality stimuli [18, 19]. Songs help learners to acquire sociocultural context of the language since they reflect the mother tongue culture [20]. Moreover, when both linguistic and non-linguistic (culture, beliefs etc.) outcomes are integrated into the learning experience, learners will attain a higher L2 proficiency [8].

In fact, the study of music and foreign language are mutually beneficial. Lowe's tested whether incorporating a music program would benefit both learning of music and a second language. She found that the group receiving daily music instructions performed significantly better than the control group in all music tests and oral grammar and reading comprehension tests. This is supported by the overlap in sensory processing when linguistics and musical stimuli are jointly presented [21, 22].

5 Issues with Music Appreciation

Pop culture dominates classical music since appreciation of pop music does not require profound academic knowledge. Furthermore, 70 % of popular hit songs concerned stages of the courtship and sex had become more intense and frequent in pop music. The music is loud, rhythmically insistent, constructed surrounding techniques of arousal and release. Therefore, by appealing to the majority, pop music easily dominates classical music [23–25].

5.1 Ethical Issues

Music appreciation is largely based on one's social strata. Cultural stereotypes e.g. taste in music, position individuals in the social hierarchy. In fact, '*nothing clearly affirms one's class than tastes in music*'. People often express a positive preference towards a variety of musical genre but an intense dislike for another genre. Generally, those of higher social strata tend to pursue highbrow tastes [26, 27].

The appreciation of highbrow music and language abilities are considered cultural capitals and are passed down generations. Endowment of such cultural capital perpetuates social inequality as schools reward students who possess such elite cultural capital by setting elitist standards [28]. This results in the Matthew Effect where wealthier students, who possess such cultural capital, perform better while the poorer students do less well in school. Consequently, the poor is absorbed into a poverty trap as seen in Fig. 1.

Music omnivorousness (openness to greater genre of music) is also considered an indicator for the higher social strata. They use their diverse musical knowledge to network and advance the social ladder [29, 30]. On the flip side, the lower social

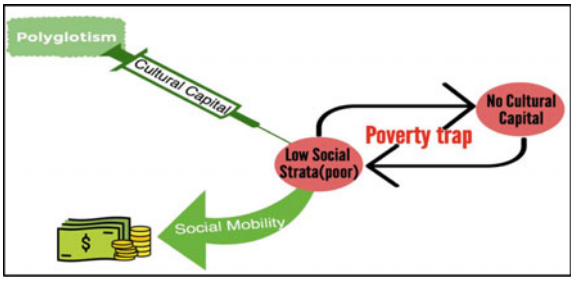


Fig. 1 Diagrammatic illustration of Bourdieu's theory of Cultural Capital and how might Polyglotism alleviate the poverty trap

strata are mostly only familiar with pop music. Therefore, by endowing the underprivileged with cultural capital, with emphasis on language and exposure to middle and highbrow music, may help to alleviate social inequality.

5.2 Pedagogical Problems

The outdated music pedagogy adopted in school curriculum led to the aversion to highbrow music. There appears to be a difference in expectations between teachers and students. Teachers think that historical context and musical elements interest the students, but the students feel 'bored, resentful and disconnected' [31]. Moreover, activities without relevance to their music preferences exacerbates their detest for music lessons and further avert highbrow music. However, those who were self-taught continued playing till adulthood [32] as they are likely to only learn *useful* and *relevant* stuff.

To enhance music appreciation, we need to redefine music. Traditionally, only classical music is considered 'music', but as pop music becomes increasingly pervasive, classifying pop music into 'music' might appeal to more people. Since the musically uneducated can relate the pop music, they may gradually develop an interest in music and learn to appreciate highbrow music.

6 Polyglotism

Polyglotism aims to work on a few key principles: providing comprehensible input, lowering affective filter to facilitate language *acquisition* and an integrated platform for both integrative and instrumental learners for successful SLA at an affordable rate. Below shows the different activities to be adapted in Polyglotism. The activities are partially derived from literature findings and current apps. The sections below will explain how the activities could effectively deliver comprehensible input to the users. The brackets below contain the abbreviation of the pedagogy or focus of the activity.

6.1 Topical Lesson Programs

Topical lessons will be featured to build a foundation for beginners and intermediates to advance their vocabulary repertoire in different domains. Flashcards (Vocabulary), completing the sentence with multiple-choice question (semantics, morphology and syntax), sentence translation (GTA) will be included as part of the normal lesson programs. Lessons are structured based on the theme to teach some content-specific vocabulary (CALLA).

6.2 Accelerated Learning (with Music)

A relevant Music Video to the topic will be played in L2 with English and L2 lyrics and visual of the song. Pop songs will be chiefly used over classical pieces to capture the interest of the learners and develop integrative motivation. Moreover, pop songs facilitate memorization and application since they contain multiple formulaic phrases that are concomitant with distinctive intonation, rhythmic and stress patterns [33].

Adapting to Suggestopedia, baroque music will be played throughout the use of the app as it relaxes the learners' mind to facilitate language learning. In particular, Mozart's sonatas help to enhance language learning as it activates the left and right brain hemispheres, which processes language and music respectively. Additionally, it improves mood and lowers the affective filter, increasing the absorption of learning materials [33, 34]. The music also stimulates the Inner Eye Visualisation technique—the ability to form images in the mind in response to a musical stimulus, to enhance music appreciation [35].

6.3 Supportive Learning Community

A supportive learning community allows learners to gain valuable feedback from native speakers and reduce the sense of isolation amongst online learners. The success in developing communicative competence hinges on the sense of community and trust, which is essential to overcome learner's anxiety and lower affective filter [36].

Partnership (CA). Polyglotism seeks to match compatible and competent language partners for learners to interact as adapted by iTalki. For example, 'A' is learning Chinese that 'B' is native to. Thus, 'B' can teach 'A' Chinese in *exchange* for French lessons from 'A'. This free language exchange platform is sustainable due to the mutual learning both language learners derive. However, such two-way learning implies that each learner cannot fully concentrate on learning only.

Tutorship (COG. and CA). The Tutorship Program has been developed by iTalki and sees *unilateral* learning for each Student [37]. This is because the paid Tutor can detail linguistic concepts that Partners may not be willing or able to do so. In this way, learning can be accelerated.

Students pay Tutors credits in amount determined by the tutors, and the credits can be exchanged for cash. Those who teach and learn are ideal users since they spend less money to learn as the credits gained are used to hire Tutors. For example, 'A' tutors 'C' to earn credit. The credits can then be used to engage 'B' to tutor 'A'. This greatly reduces the net expenditure. After each session, the student will leave a rating for the Tutor to incentivize the Tutor to teach the students properly since good ratings will get them more business.

However, communication barriers between 'Partners', 'Tutors' and learner might arise, especially if the user communicates using logograms and alphabets. On that note, the algorithm will try to pair up students and tutors who have a common fluent language. This might favour the multilingual at the expense of the monolingual. Therefore, a translation and transliteration tool can be adopted to reduce the communication wall just as Hello Talk had implemented.

HomeWork. HomeWork will be issued to the learners and assessed by native speakers. It consists of text translations (GTA) from English to French, essay/questions or responses (CA, Cog.), audio recordings of text (phonology), which are the classic skill-based tests. This facilitates learners to gain proficiency in syntax, semantics, morphology, pragmatics and phonology. Moreover, such assignments obtain useful feedbacks from native speakers to rectify the users' pronunciation, grammar, etc.

Academic Lectures (CALLA). At an intermediate level, the learners would have developed sufficient language proficiency to be exposed to authentic lectures to learn content-specific vocabulary [38]. Since language becomes more decontextualized and denser at higher level, science and arts will be beneficial at this stage. Science develops content knowledge through an inquiry approach to teach students to construct hypothesis, describe and explain; the Arts enables student to grasp abstract ideas rooted in philosophy [13]. Additionally, academic lectures fulfill the CEFR rubrics of a 'Proficient User' as it develops learner's ability to summarise information from spoken sources, differentiate finer shades of meaning in complex situations and use language for professional or academic purposes [39].

According to Cummins' Common Underlying Proficiency (CUP) theory, lectures develop the Cognitive Academic Language Proficiency (CALP) component of CUP [40]. Theoretically, both native language (L1) and L2 will improve as CUP expands as seen in Fig. 2., but L2 will be chiefly developed as the learner acquires new *content-specific vocabularies*. Moreover, the huge CUP developed by the language learners through prior academic education in school facilitates learners' progress in L2.

In mind of that, Polyglotism seeks to adapt lecture videos of various disciplines from universities to assist language learners to develop CALP. MIT has shared their course content via OpenCourseWare to the public and is rallying other universities

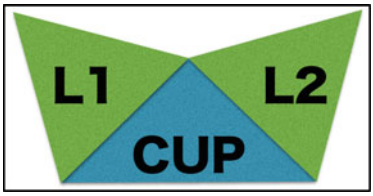


Fig. 2 Illustration of Cummins' Common Underlying Principle Proficiency (CUP) [40]

to follow suit [38]. Thus, Polyglotism can work with such universities and recommend lecture series to learners based on their interests and level. Credits may be charged for certain lecture series that are rare in the L2.

6.4 Gamification

Gamification is crucial to captivate and motivate users and should be relevant to the underlying activity to induce the compulsion loop.

Credits. Credits are chiefly used to hire 'Tutors' and gain access to some lecture series. They can be gained by contributing to the Polyglotism community such as: leaving feedback on the users' HomeWork, tutoring 'Students', completing voluntary surveys and by exchanging game points from normal lessons. Such 'Token Rewards', where subjects can exchange their tokens for something are well liked by subjects and they stick to it for long periods [41]. This system fully assimilates gamification into the personal objectives of the user (to gain credits to hire 'Tutors') and absorbs the users into the compulsion loop. Therefore, the Credits system can sustain a long run interest in the app since there is a meaningful integration of it.

6.5 Crowdsourcing

To increase affordability, other sources of revenue needs to be explored to cover costs without compromising learning. Crowdsourcing presents a win-win solution to cost issues.

Translation (GTA). Capitalising on the $37 billion USD [42] translation industry, Duolingo made learners translate L2 into their native language as part of learning. The software breaks down long texts into sentences and sends them to learners of appropriate level to translate. The best translation amongst many students will be combined into an entire text before selling it to the clients to generate revenue.

Answering Survey Questions (CALLA). Businesses conduct market research before investing. Online surveys are becoming prevalent due to the increase network coverage and this presents a golden opportunity for Polyglotism to crowdsource in the $40.3 billion USD industry [43]. Personal information and preferences are required to categorise learners to answer the questions prepared at the end of the

Topical Lessons (Sect. 6.1). The learners are encouraged to answer the questions that come in MCQ and open-ended questions. Credits are awarded for surveys done. Open-ended questions are set under HomeWork (Sect. 6.3), where a question relevant to the topical lesson will be asked and native speakers will assess their responses. This generates revenue while providing additional learning platforms.

7 Conclusion

There are empirical evidences to show causal links between music and SLA. Studies suggest that music lowers affective filter, improves prosodic memory, develops sociolinguistics and is especially effective for SLA when presented with extralinguistic stimuli. Moreover, Lowe's experiment concluded that the learning of a foreign language and music is mutually beneficial [21]. It has been discovered that music appreciation is a deep-rooted issue as it is socially stratified and exacerbated by the ineffectual music pedagogies in public schools. Furthermore, music and language education are considered cultural capitals and their inheritance intensifies social inequality through the Matthew effect and poverty trap. Lastly, studies suggest that effective gamification should integrate the underlying learning goals to draw learners into the compulsion loop.

The incessant demand for language learning spawns numerous researches into Mobile Assisted Language Learning (MALL) in the recent decades to increase public access to quality education. Polyglotism has incorporated some pedagogies and improved ideas from language apps to support language learning for integrative and instrumental learners. The activities in Polyglotism are supported by linguistic literatures and suggest great potential to be used as an useful e-learning tool. The social objective of Polyglotism can be achieved through effective gamification and activities to equip learners with cultural capitals to reduce the extent of inequality. Exploring crowdsourcing ideas may cover developmental costs. However, user studies have not been conducted to understand the efficacy of adapting classroom pedagogies into e-learning. Primary research remains to be done to finesse Polyglotism according to the preferences of the learners.

References

1. ICEF Monitior: Globalised economy continues to drive demand for foreign language proficiency (2013)
2. Ahn, L.V.: Educacion Masiva Para El Futuro. (Video) TEDxRiodelaPlata, South America (2014)
3. Gordan, L.: Korean-Language Classes are Growing in Popularity at U.S. Colleges. Los Angeles Times. http://www.latimes.com/local/education/la-me-korean-language-20150401-story.html (2015)

4. Vanhoenacker, M.: Requiem: Classical music in America is dead. http://www.slate.com/articles/arts/culturebox/2014/01/classical_music_sales_decline_is_classical_on_death_s_door.html (2014)
5. Sharpies, M.T., Vavoula, O.: Towards a theory of mobile learning. In: Proceedings of Learn 2005 Conference (2005)
6. Smith, A.: U.S. Smartphone Use in 2015. Pew Research Center (2015)
7. Krashen, D.S.: Second Language Acquisition and Second Language Learning. Pergamon Press, Oxford (1981)
8. Holt, J.N.: Motivation as a contributing factor in Second Language Acquisition. In: The Internet TESL Journal, vol. VII, no. 6, Aichi Shukutoku High School, Nagoya, Japan (2001)
9. Dörnyei, Z.: Conceptualizing Motivation in Foreign-Language Learning. Language Learning Research Club, University of Michigan, Michigan (1990)
10. Chomsky, N.: Aspects of the Theory of Syntax. The M.I.T. Press, Cambridge (1965)
11. Auburn University, Approaches to Teaching English as a Second Language. The Communicative Approach. http://www.auburn.edu/~nunnath/engl6240/clt.html
12. Canale, M., Surain, M.: Theoretical Bases of Communicative Approach to Second Language Teaching and Testing. The Ontario Institute for Studies in Education (1980)
13. Chamot, A.U., O'Malley, J.M.: A Cognitive Academic Language Learning Approach: An ESL content based curriculum. National Clearinghouse for Bilingual Education, Washington, DC (1986)
14. Krashen, D.S.: Principles and Practices in Second Language Acquisition. University of Southern California, California (1982)
15. Lazanov, G.: Suggestopedia—desuggestive teaching communicative method on the level of hidden reserves of the human mind. In: Speech at the meeting of the 20 UNESCO experts (1978)
16. Berns, A.: Foreign Language Learning Using a Gamificated App to Support Peer-Assessment. University of Cadiz, Cadiz (2014)
17. Nicholson, S.: A User-Centered Theoretical Framework for Meaningful Gamification. School of Information Studies, Syracuse University, New York (2012)
18. Medina, S.L.: The Effects of Music Upon Second Language Vocabulary Acquisition. ERIC Library (1990)
19. Sharifian, F.: Memory enhancement in language pedagogy: Implication from Cognitive Research. Edith Cowan University, Mt Lawley (2002)
20. Murphey, T.: Music and Song. Oxford University Press, Oxford (1992)
21. Nadera, B.: Promoting Student Motivation in EFL Classroom: Through Extended Music Education. The Preparatory School of Economics Tlemcen, Algeria (2015)
22. Cavey, J.V., Hartsuiker, R.J.: Is there a domain-general cognitive structuring system? Evidence from structural priming across music, math, action Description and language. Department of Experimental Psychology, Ghent University, Ghent, Belgium (2015)
23. Hirsch, P.M.: Sociological Approach to the Pop Music Phenonmenon. Universitiy of Michigan, Michigan (1971)
24. Andsager, J., Roe, K.: "What's Your Definition of Dirty, Baby?": Sex in music video, vol. 7, Issue 3, pp. 79–97. School of Journalism and Mass Communication, University of Iowa, Iowa, USA (2003)
25. Donze, P.L.: Popular music, identity, and sexualisation: a latent class analysis of artist types. Poetics **39**(1), 44–63 (2011) (Science Direct)
26. Reeves, A., Gilbert, E., Holman, D.: Class Dis-Identification, Cultural stereotypes, and Music Preferences: Experimental Evidence from the UK. Department of Sociology, University of Oxford, Oxford, United Kingdom (2015)
27. Savage, M.: The musical field. Cult. Trends **15**(2/3), 159–174 (2006)
28. Tzanakis, M.: Bourdieu's social reproduction thesis and the role of cultural capital in educational attainment: a critical review of key empirical studies. Educate **11**(1), 76–90 (2011)
29. Peterson, R.A., Kern, R.M.: Changing highbrow taste: from snob to omnivore. Am. Sociol. Rev. **61**(5), 900–907 (1996) (American Sociological Association)

30. White, C.G.: The effect of class, age, gender, race on musical preferences: An examination of the Omnivore/Univore framework. Thesis for Master of Science for Sociology. Faculty of Virginia Polytechnic and State University, Blackburg, Virginia (2001)
31. Silverman, M.: Rethinking Music Appreciation. New York University, New York (2001)
32. Bowman, W., Coan, D. A., Regelski, T.: Reconnecting music education with society. ACT J. (2006)
33. Rokni, S.J.A., Atnee, A.J.: The Effect of Background Music on Vocabulary Recall and Retention of Children Learning English as a Foreign Language. English Department, Golestan University, Iran (2014)
34. Swartz, L., Nilsson, N.: The "Mozart Effect" Does Mozart Make You Smarter? CS 99L —"How Are We To Learn". Stanford University, California (2000)
35. Cranmer, D., Laroy, C.: Musical Openings: Using Music in the Language Classroom. Addison Wesley Longman Limited, Essex (1992)
36. Hampel, R., Stickler, U.: Online teaching skills for language tutors. Centre for Language and Linguistics & Area Studies (2009)
37. iTalki: Learn a language. https://www.italki.com/home
38. Sun, Y.C., Yang, H.C.: Do Language Proficiency and Lecture Comprehension matter? OpenCourseWare Lectures for Vocabulary Learning. National Chiao Tung University, Taiwan (2012)
39. Council of Europe. Common European Framework of Reference for Languages: Learning, Teaching, Assessment (CEFR). Cambridge University Press
40. Haynes, J.: Getting Started With English Learners. Chapter 2. How Students Acquire Social and Academic Language. Association for Supervision and Curriculum Development (2007)
41. Hulse, S.H., Deese, S., Egeth, H.: The Pschology of Learning, 4th edn. McGRAW-HILL (1975)
42. The Economist: Say What? http://www.economist.com/news/business/21642187-technology-may-not-replace-human-translators-it-will-help-them-work-better-say-what (2015)
43. Statista: Statistics and Facts in the Market Research Industry (2013)

Gaze-Based Real-Time Adaptivity and Adaptability in an eLearning Environment: A Pre-release Insight

Holger Schmidt, Alexander Henka and Gottfried Zimmermann

Abstract As part of the *ScienceCampus Tübingen*, we conduct empirical research on learning strategies, in particular with regard to system adaptivity. For this purpose, we developed a web-based eLearning platform called ALM (Adaptive Learning Module) which adapts the learning content based on a real-time analysis of the user's gaze data as observed by an eye-tracker. This paper describes work in progress and provides a technical insight on the state of our platform and how we plan to shape the application for the planned open-source release this fall. In addition to the technical overview, we provide application examples from actual research studies as well as a vision for the productive use of the learning environment for educational topics.

Keywords Eye-Tracking · Gaze-Tracking · Gaze-Based interaction · eLearning platform · Eye movement · Fixations · Transitions · Gaze events · Eye movement modelling · Eye movement analysis · Gaze analysis · Web-based eLearning

1 Introduction

Founded in 2009, the *ScienceCampus Tübingen (Germany)* [1] researches education in informational environments. Within this campus, the AAMS (Adaptive and Adaptable Multimedia Systems) project is focused on learning with multimedia. AAMS consists of several subprojects. While the universities of *Freiburg (Germany)* [2, 3] and *Tübingen (Germany)* [4] are researching the psychological aspects of

H. Schmidt (✉) · A. Henka · G. Zimmermann
Responsive Media Experience Research Group (REMEX),
Stuttgart Media University, Nobelstrasse 10, 70569 Stuttgart, Germany
e-mail: schmidtho@hdm-stuttgart.de

A. Henka
e-mail: henka@hdm-stuttgart.de

G. Zimmermann
e-mail: gzimmermann@acm.org

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learning in multimedia environments, the *Stuttgart Media University (Germany)* [5] is responsible for technical research and implementation.

The focus of this combined research effort is on gaze-based user interaction in eLearning sessions, using a web-based learning environment to adapt the learning content to the learners' needs and requirements. Here, an adaptive learning module —called ALM—was designed to create, manage and enhance online learning courses with adaptive behavior functionality. ALM is still in development, and recently reached a new milestone that enhances its functionality to adapt the learning content. Based on this new user interface capabilities, ALM is able to present learning content in a modular and adaptable way.

New highlighting functions extend the adaptive aspect of our learning platform. For instance, learning content can be represented as popup for a fixed time or exchanged by modified versions of the content. ALM can influence the sequence of the learning content by controlling the "continue button" between learning units or by jumping to another point of the learning unit tree. The adaptivity is triggered by several values like timers, gaze-fixations, gaze-transitions, clicks and hovers. The author is free to choose the adaptive behavior for each learning unit to accommodate the learners' needs.

For further personalization we have developed an "annotation tool", which allows the learner to draw custom markings on the learning content and to annotate specific areas of the learning content they have considered to be important. The drawings and annotations are saved for later repetitions of the learning content.

A major part of the new ALM features is the *author's environment*, which allows the setup of a learning course. We implemented user interfaces for most of the fundamental course preparation steps: starting with the creation of a new learning unit including unit specific settings, followed by adding and editing content objects called "widgets", adding new unit tasks (i.e. content related rapid assessment tasks) which appear after each learning unit, setting up assistive tools and finally adding areas of interest and adaptive script components. The author's environment includes text editors, file uploads, import and export functions, menus for unit task editing and—most importantly—a graphical editor to define areas-of-interest for the gaze-based adaptivity. Previous versions of ALM required the author to do several editing steps outside the learning environment, i.e. creating learning unit tasks had to be implemented manually by editing the course *XML* files.

For research purposes, ALM logs the learners' gaze movement, the answers given to unit tasks and all timestamps for the events. The research work of the project partnership separates in psychological and technical efforts. On the technological side, the *Stuttgart Media University* researches the technical implementation for desktop and mobile devices, and usability aspects of the developed learning environment. The psychological research is driven by the other three partners. They focus on self-regulated learning (the learner adapts the learning content and environment for his needs) and adaptive system behavior (the learning environment adapts its learning content and visualization based on the learners' inputs in order to improve the learning process).

This paper is work in progress and provides an overview over the ALM system architecture (Sect. 2) with regard to the upcoming open-source release this fall. The use of the learning platform for research purposes is described (Sect. 3) as well as possible application scenarios for education and the next steps of development and release (Sect. 4). We discuss the features in detail and provide insights on the benefits, in the context of eLearning, and how the overall system—by using gaze-based real-time adaptivity—can improve the learning experience of a learner. We also discuss the results of a study which we conducted to evaluate the usability of ALM and of the annotation tool in particular.

2 System Architecture of the Learning Platform ALM

The adaptive learning module, called ALM, is designed and developed as a modern web-based eLearning platform. Early versions of ALM were only able to work as plugin for the eLearning platform *ILIAS*; however, the latest version of ALM can also be used as a standalone server application, with the full set of necessary components and features.

A unique feature of ALM is its adaptive capability based on the user's gaze in relation to specific content areas. The gaze data are captured using regular eye-tracking technology. The logic for the processing of gaze data is allocated in the learning applications' frontend, where the content adaptation is performed using *JavaScript* and modern *HTML* features.

The frontend of ALM itself differs for various user roles, e.g. a learner, a professor, author, or admin. Depending on the user's role, they get to see different presentation and editing views and have different rights for reading and editing of content.

The data link between the eye-tracking hardware (where the gaze data originate) and the learning application (where the gaze data are collected) is called *iTrackServer*. The *iTrackServer* takes the raw gaze data from the eye-tracking hardware, and passes them on via *WebSockets* to the learning application running in a web browser (see left side of Fig. 1). Thus, the stream of gaze data, which would usually go directly to a proprietary gaze tracking and analysis application, is diverted to the *ALM* frontend running inside a web browser for the purpose of making the web-based learning platform adaptive at runtime.

The integrated web-based eye-tracking framework facilitates core functionalities of the platform such as the learner model drawn from the analysis of process data captured. The system analyzes the eye movement in real-time to adapt the learning progress and content. It also records and stores the learner's eye movement data to be available for further analysis beyond the learning session.

The *ALM PHP Modules* take care of backend functionalities such as the resource management, the learning content management, the access rights management and the user management.

The *ILIAS Plugin Interface* (which is missing for the standalone version of the platform) is integrated in the backend and provides complementary management

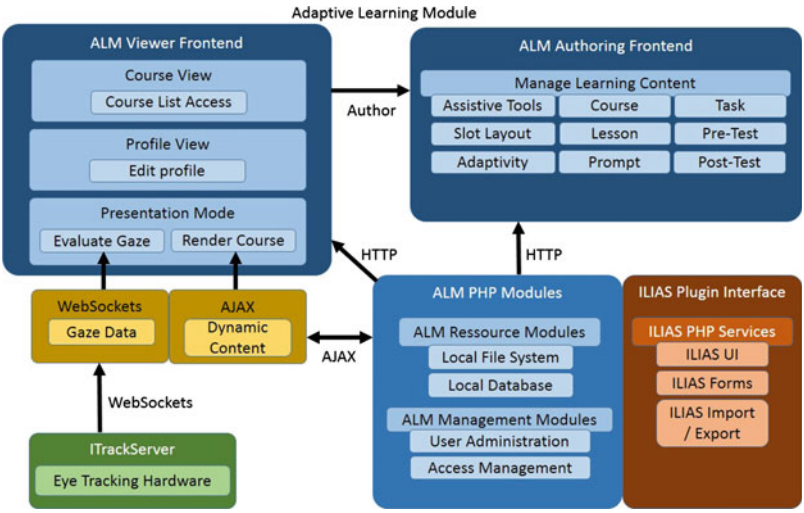


Fig. 1 Architecture of ALM (adaptive learning module)

functions provided by the *ILIAS framework* [6] such as user, rights and content management. Wassermann et al. [7] provided a detailed description of the ALM system architecture and the technique of gaze-based interaction.

2.1 ALM Viewer Frontend

The *Course View* is the first view after logging into the learning platform ALM. It provides the user with a list of available learning courses, including a short description of course content. From this "hub" the user has access to the *Profile View,* which gives access to the learner's profile. The learner can select a course from the *Course View* and start the *Presentation Mode*. In combination, the *Course View*, the *Profile View* and the *Presentation Mode* are called the *ALM Viewer Frontend*; illustrated in Fig. 1.

Figure 2 shows a screenshot of the *Presentation Mode.* The actual layout varies, depending on the author-chosen template and presentation for the course.

On the backend side, the *ALM PHP modules* (see Fig. 1) are responsible for the generation of the *ALM Viewer Frontend* via PHP rendering. The *ALM PHP Modules* contain templates and content for the course presentation. The learning content resources are loaded dynamically via *AJAX* communication between the *ALM Viewer Frontend* and the systems backend, the technical and structural fundament of ALM.

Further functionalities and scripting, such as interactive or dynamic components, are provided by *JavaScript* functions. The *WebSocket* communication with the

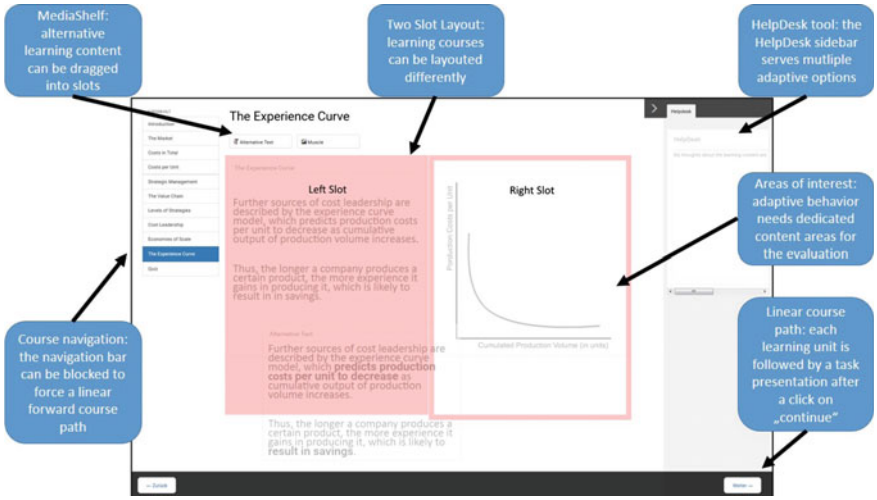


Fig. 2 Presentation Mode example with various tools

connected eye-tracking system is based on an interface that links to external eye-tracking sources, like the *iTrackServer*. This Server tool was developed as part of this project for the purpose of converting the raw data stream of the eye-tracking driver from a TCP-based data stream into a *WebSocket* interface stream to be compatible with the web browser.

2.2 ALM Authoring Frontend

A second frontend, the *ALM Authoring Frontend,* is designed for course authors with extended access and editing rights. This is a sophisticated user interface to prepare and editing learning courses similar to other learning management systems (LMS). Figure 3 shows a screenshot of the Authoring Frontend.

There are multiple steps necessary to create a complete adaptive learning course. The author is guided along these steps by menus. First, the author needs to create a new learning course container. There are multiple course-related options to choose from, such as title, description, access rights and adaptivity status. In the second step, the author can add any number of learning units to the course. There can be active learning units (in a standard linear course) and additional inactive learning units (for adaptive purposes like alternative course paths). Each learning unit can have its own presentation layout. The most common layout is the so-called 2-slot-design which has been used in most of the project's studies.

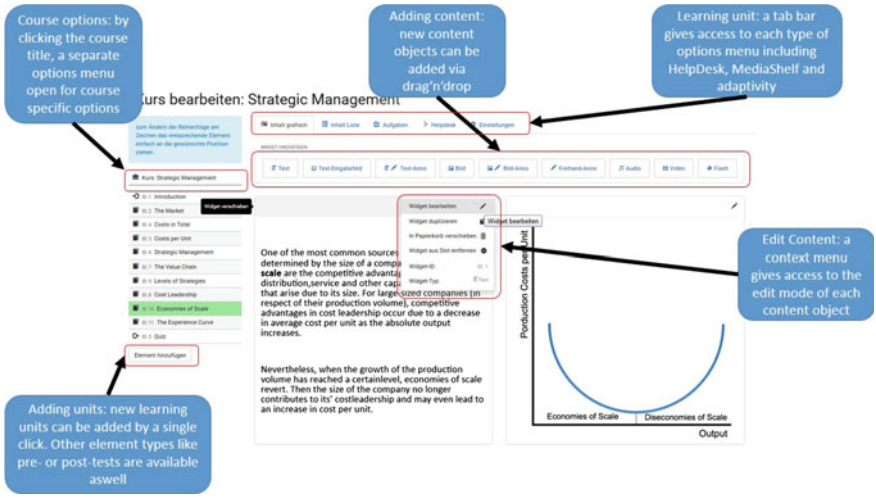


Fig. 3 Screenshot of the ALM Authoring Frontend

A learning unit contains any number of content containers, each holding a single learning content object. These containers are designed for layouting purposes of the learning unit (grid layout and dragging functionality for content objects). Learning content can be any multimedia content like text, image, video, audio or flash objects. There is a dedicated container type designed for every type of content, alongside with a specific editing menu offering media-type related editing options such as: file upload, edit title and description, edit content (in case of text content), and set additional options. The author can choose the position of the content objects in the learning unit freely, respecting the unit slots and boundaries. Learning content objects can also be defined as inactive and therefore be invisible to the learner. These inactive components are as well designed for adaptive use.

Additionally, a learning unit can contain unit tasks. The most common use of these tasks is to present content related questions, like rapid assessment tasks. With the help of the system's adaptive capability, the author can define automated assessments of the learner's answers to trigger adaptive behavior based on the answers. This advanced functionality is implemented by adding small parts of *JavaScript* to each content object, which requires a basic programming knowledge. More information about the adaptivity capabilities of ALM can be found in Sect. 2.4.

2.3 Assistive Tools

We developed three integrated adaptive tools which enable learners to customize the learning environment: The *MediaShelf*, the *HelpDesk* and the *Annotation Tool*.

The learning platform serves these assistive tools to assist a learner in their learning experience.

The MediaShelf (see top of Fig. 2) is a toolbar that can be placed on the right side of the screen or above the learning content. The author can place additional learning content objects (such as video descriptions or more detailed text explanations) on the MediaShelf and select content objects from the MediaShelf by dragging the objects onto predefined content presentation slots of the learning unit. The author can define the behavior of the MediaShelf in cases where a learner drags content from the shelf to a presentation slot already showing content. The behavior options are: Replacing the shown learning content or placing the dragged content object below existing content as an additional widget. In the same way learning objects can be returned to the MediaShelf.

The *HelpDesk* tool (see Fig. 2) is placed at the right side of the screen and provides additional help texts and free space for the learner's notes. The author can make the HelpDesk's behavior adaptive by defining specific situations (based on gaze data) in which the HelpDesk would automatically be shown (expand) or hidden (collapse). The HelpDesk can also host the MediaShelf on the side of the screen with its capabilities described above. It can also host content-related unit tasks, which can be evaluated as part of the system's adaptive behavior.

With the *Annotation Tool* (see Fig. 4), the learner can use a virtual pen to directly annotate the learning content by highlighting or underlining the content. Furthermore, the tool offers areas in which the learner can draw free-hand figures, diagrams or notes. The system automatically saves the drawings and annotations for a later revisit or analysis, in a screen-size-independent format. Figure 4 shows some example screenshots of the Annotation Tool.

2.4 System-Provided Adaptivity

ALM facilitates adaptivity by offering *JavaScript* based functions that can be employed by the author to control the adaptive behavior of the learning platform in response to user behavior [8]. These adaptivity functions are based on the learner's gaze movements and their answers to unit tasks.

ALM tracks a learner's gaze movement and counts the fixations on the learning content. For this purpose, the course author defines areas of interest (AOIs) when setting up the learning course. Hereby, ALM can compare the tracked positions of the gaze fixations to the areas of interest. The fixations on these AOIs are recorded with the AOI's unique identifier, a timestamp, the duration of the fixation and the gaze position. ALM also tracks the gaze transitions between valid fixations, to keep track of the gaze interaction between AOI elements.

ALM serves two basic types of adaptive behavior based on the individual evaluation of the learners' inputs by manipulating either the learners' progression through the learning course (global course adaptivity) or the content objects itself (local content adaptivity).

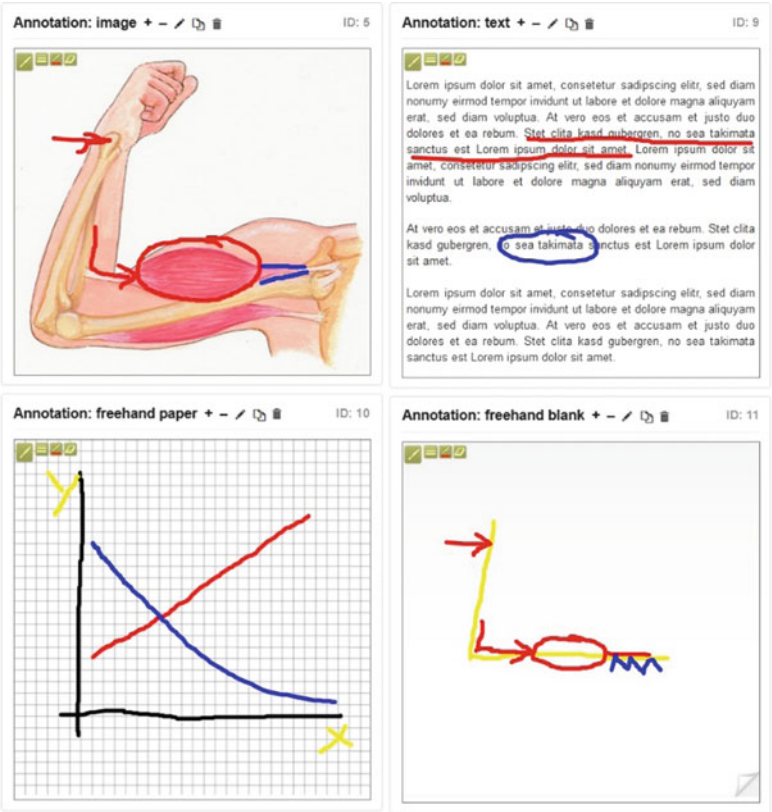


Fig. 4 Use cases for the ALM annotation tool. Pictures can be annotated (*top left*), passages of text can be underlined or circled (*top right*), and free drawings can be made on a plane with a squared or empty background (*bottom left* and *right*)

Examples of *global course adaptivity* are: The author can temporarily interrupt the ability to progress to the next learning unit by blocking the "continue" button. The same behavior can be added to tasks and popups in general. Another global adaptive function is the redirection to different learning units also called "unit jumps". An example would be a "back-jump" to a prior learning unit to force the learner to review this content or to create versions of the same learning unit but with different difficulty levels. Based on the learner's actual results the "jump" can be used to direct the learner to one of these difficulty paths. This opens a wide variety of course path options. We will further develop ALM's tree structure feature and evaluate its role in adaptive learning in future adaptive eLearning studies.

The *local content adaptivity* is based on an individual content object of a learning unit. There are two types of content adaptation implemented at the moment: content highlighting and content re-presentation. The learning content can be presented differently to its original presentation (see Fig. 5, upper left image) by

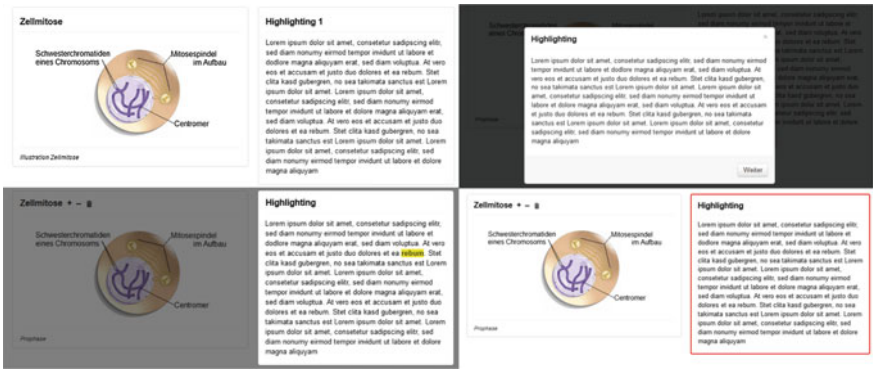


Fig. 5 Examples for content highlighting. *Upper left* original presentation; *upper right* highlighting by popup; *lower left* highlighting by focus; *lower right* highlighting by *red* borders

using highlighting functions. Content objects can be focused by "greying out" the rest of the screen (Fig. 5, lower left image). A similar highlighting can be done with red borders around the highlighted areas (Fig. 5, lower right image). A single content object can be presented as separated popup in the middle of the screen with greying out the rest of the screen (Fig. 5, upper right image). These are just examples of the highlighting methods. ALM can be individualized at any time.

Re-presenting content works basically the same way as a "highlighting-by-popup" method. The re-presentation can contain a single content object or it can contain a full learning unit. The author is capable of modifying the re-presentable content by using highlighting methods combined with additional modifications like exchanging text passages or serving alternative images with more details.

Additionally ALM provides programmable interfaces for every interactive component of the learning platform, like the *MediaShelf*, the *HelpDesk* or the Navigation. With these methods at hand, an author can compose a complex set of interactive presentation methods, for complex and controlled learning situations.

3 Using the Learning Platform for Research Studies

This chapter depicts an example of a psychological study conducted with ALM. The focus of this research study was to detect knowledge gaps in learners.

Rapid assessment tasks [9, 10] are small tasks interspersed in the learning environment for analyzing a learner's learning processes. ALM can detect knowledge gaps by evaluating eye-tracking information as well as information by rapid assessment tasks. This happens at the moment these gaps appear while the learning process is ongoing. The advantage of such a setup is that the effort needed to repair these knowledge gaps is minimized, which can otherwise substantially hinder the further learning progress.

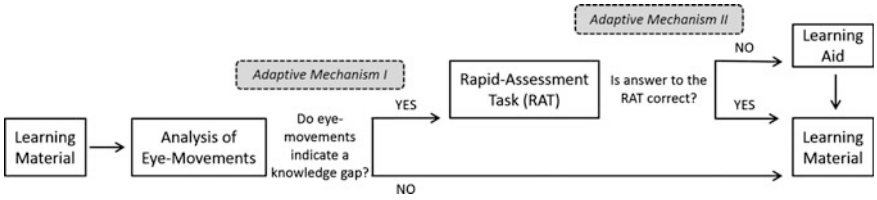


Fig. 6 Learning process with adaptive behavior. After the presentation of the first set of learning content the system initiates further rapid assessment tasks before continuing to the next set of learning content based on the learners evaluated gaze data

For detecting the majority of knowledge gaps a large amount of rapid assessment tasks is needed which is time-consuming and potentially also interrupting learning processes. Evaluating eye movement indicators of potential knowledge gaps can help to reduce the number of necessary rapid assessment tasks. If the system detects a potential knowledge gap, a rapid assessment task is used for verification of the gap. If necessary, a specific learning aid is presented to redirect the learner's focus to the missed information (see Fig. 6).

This adaptive two-step procedure is sensible due to the fact that each step—taken alone—has clear disadvantages. Relying on rapid assessments alone increases the required number of such tasks, with the aforementioned disadvantages of time costs and interruption of learning processes. Using eye movement alone is a less evident indicator of knowledge gaps as compared to using rapid assessment tasks. The advantage of eye-tracking is, however, that it does not negatively impact the learning process.

Learners with high prior knowledge may gather information with significantly short fixations or even by parafoveal processing [11]. An implementation relying on eye-tracking only might produce false positives if not verified by rapid assessment tasks. A major goal of including eye movements is the reduction of the amount of necessary rapid assessment tasks without lowering learning outcomes. Qualified eye movement indicators for knowledge gaps should be both: neither be too "liberal"—leading to unnecessary rapid assessment tasks—nor be too "conservative"—risking to miss some of the knowledge gaps. The research study of this topic is still ongoing.

4 Discussion and Next Steps

In this paper, we presented work in progress and highlighted the current status of our gaze-based adaptive eLearning platform ALM. With the *MediaShelf*, the *HelpDesk* and the *Annotation Tool,* we illustrated and discussed the latest adaptivity features to support the needs and requirements of learners and to enrich their learning experience.

With the new ALM version, the learning content can be separated into learning courses. Each learning course itself is separated into learning units which are per default listed as a linear course. Adaptivity scripts towards a full tree structure can extend the linearity of a course. The adaptivity scripts can control the learning path through such a tree structure course as a calculation of gaze behavior and knowledge of the learner based on the answers given to presented tasks.

As stated, ALM is still work in progress, with new components planned for the future to support an adaptive learning experience beyond the current state. As a major new feature, we plan to *make the learning platform's layout responsive* to the screen size of the learner's device. Hereby, a learner will be able to take a course on their individual presentation devices e.g. desktop computers, laptops, media-pool terminals or tablet computers.

Since learners feel more confident using their own distinct devices when taking a course, the planned *in-browser calibration* provides the technical foundation for using ALM on different devices with various eye-tracking technologies. With ALM's in-browser calibration, we can calibrate a connected eye-tracking device via the browser on the learner's device. Moreover, the in-browser calibration provides the necessary interfaces for multiple eye-tracking hardware devices. An initial description of the in-browser calibration is provided in [12].

We plan for an open-source release of ALM this fall. We imagine that ALM could be used as productive online education environment for various purposes.

These complex and dynamic courses can be used to adapt to the learner's pre-knowledge or their capability of learning this specific content. The adaptivity can also be used to increase a learner's quantitative and qualitative learning outcome by selecting more challenging paths through the course. This is only based on the individual presentation sequence of learning units, the course meta layer. Besides these possibilities, the adaptive capabilities of ALM are primarily designed to adapt on a more local basis by altering and re-presenting learning content within a single learning unit. Hereby, ALM is able to modify single content objects on a visual basis or with regards to the content itself, based on the learner's answers and gaze behavior on single content areas or between multiple content areas. Using these methods, the complex adaptive course structure and local adaptive learning units, ALM can provide for dynamic learning courses, which can adapt to individual learner requirements, on multiple platforms. Due to the mobile presentation capability, a learner would be able to personalize their own learning process depending on their own preferences in various contextual situations (learning places), such as at the university, in a train or at home.

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References

1. ScienceCampus Tübingen. https://www.wissenschaftscampus-tuebingen.de/www/en/index.html?ref=folder5 (2016)
2. Plötzner, Rolf, University of Education Freiburg. https://www.ph-freiburg.de/imb/institut/institutsleitung.html (2016)
3. Renkl, Alexander, University of Freiburg. https://www.psychologie.uni-freiburg.de/Members/renkl (2016)
4. Scheiter, Katharina, Knowledge Media Research Center Tübingen. https://www.iwm-tuebingen.de/www/en/mitarbeiter/ma.html?uid=kscheiter (2016)
5. Zimmermann, Gottfried, Stuttgart Media University. https://www.hdm-stuttgart.de/forschung_transfer/forschungsschwerpunkte/responsive_media_experience/team/zimmermann (2016)
6. Ilias 4 Open-Source Framework. http://www.ilias.de/docu/goto_docu_wiki_wpage_2718_html (2016)
7. Wassermann, B., Hardt, A., Zimmermann, G.: Generic Gaze Interaction Events for Web Browsers: Using the Eye Tracker as Input Device, Lyon (2012)
8. Schmidt, H., Wassermann, B., Zimmermann, G.: An adaptive and adaptable learning platform with real-time eye-tracking support: lessons learned, Freiburg (2014)
9. Kalyuga, S., Sweller, J.: Rapid dynamic assessment of expertise to improve the efficiency of adaptive e-learning (2006)
10. Renkl, A., Skuballa, I.T., Schwonke, R., Harr, N., Leber, J.: The effects of rapid assessments and adaptive restudy prompts in multimedia learning (2015)
11. Schwonke, R., Berthold, K., Renkl, A.: How multiple external representations are used and how they can be made more useful (2009)
12. Harich, N., Gebauer, S., Schmidt, H., Zimmermann, G.: Cross-Platform Web Framework for Gaze Tracking, Venice, Italy (2016)

Study on Practicing, Teaching and Sharing on Design for Sustainability in China

Mingyue Lyu

Abstract This paper aims to study the feasibility of DFS (design for sustainability) in China from "ideas" to "execution". The feasible practice ways on DFS in China include taking advantages of Lens-China platform, application of systematic views and valuing the social innovation. The features of "teaching" and "learning" in different institutions are analyzed in China. This paper also gives some proposals about how to share these experiences of practicing and teaching of DFS, meanwhile analyzes the advantages and feasibility of such proposals. In short, design interventions must adapt to China's national contexts. To verify theories and determine the practical guidelines of DFS in China, practitioners need to practice frequently, and simultaneously share these practicing experience through many channels, in order to find out a set of effective practice methods and teaching mode.

Keyword Design for sustainability in China · Practicing · Teaching · Sharing

1 Introduction

Although the design world has generally realized the urgency of DFS demand, just a few DFS projects have been carried out in China while most projects are more like conceptual designs. This phenomenon has two causes:

Firstly, DFS is a developing concept in China, which is vaguely defined and is not provided with any applicable assessment system to China, so it is hard to forecast or judge whether these projects are "sustainable".

Secondly, what students have learnt are mostly western DFS theories, but the disconnection between theory and practice exists even in western countries. In view of the difference between Chinese and foreign contexts, a lot of theories cannot be

M. Lyu (✉)
Academy of Arts & Design, Tsinghua University, Beijing 100084, China
e-mail: Lumoon@163.com

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directly applied, so students often have no clues about what to do though they have discovered some problems in practice. Therefore, the author, based on the research experience in the LeNS-China project, explores the feasible practicing approaches in recent years and summarizes different teaching experiences of Chinese universities, in order to facilitate the development of DFS from research to practice.

2 Feasible Approaches for Implementation of DFS Ideas

2.1 *A Platform of LeNS-China[1] to Share Teaching and Practice on DFS*

LeNS-China is originally designed to act as an online resource database for DFS teaching, so that students, teachers and other colleagues can get to know the updates of the development of practicing and theories of DFS. It originates from the European LeNS project,[2] however with some obvious differences. In Europe, only those who have registered as LeNS members can share case studies and course materials offered by the website, while LeNS-China is open to the public for free in China and anyone can browse and download all the materials on the website for modification, which need to be explained simultaneously as source for such modification, in order to protect legal copyright. In this sense, all data on LeNS-China is "completely shared" with "no threshold".

LeNS-China also aims at providing a supporting platform and associated network for crossover cooperation in DFS. Though it is hard to practice the theory, opportunities and inspirations to fulfill DFS still exist, as many enterprises have been clearly aware of the huge business opportunities in the issue of environmental protection and what they still lack is the thinking of how to connect social/corporate demands with DFS. LeNS-China itself concerns "sharing" of information and teaching to serve design, which provides various possibilities for interdisciplinary horizontal cooperation in different fields of DFS in China, to achieve mutual assistance among different institutes and individuals since it is open, available and professional.

[1]LeNS-China (The Learning Network on Sustainability in China: http://www.lens-china.org) is a branch of LeNS project in China, which is constructed by a number of universities and social institutions in China and committed to research, teaching, practice and information spreading of DFS in China.

[2]LeNS project (The Learning Network on Sustainability: http://www.lens.polimi.it) is an important cooperative project among international educational institutions, which aims at promoting exchange and cooperation between international universities in research, teaching and practice of "DFS".

2.2 A Systematic Design Perspective Instead of an Isolated Design Strategy

DFS requires designers could understand the interaction among four dimensions including economy, society, culture and environment, and consider intervention of design from a systems perspective instead of at technical or aesthetic level. Some experts even believe that systems perspective is the unique solution to sustainability [1], which is practiced mainly through the following three channels in China:

Firstly, systematic innovation is developed for the whole design process. For the purpose of integration of products and services, School of Design, Jiangnan University constructed a macroscopic system organization first of all and then carried out microscopic design implementation [2]. The specific implementation focused on solutions to actual business problems, development of supporting tool kits and construction of business model analyses by new information means to create business value. It should be noted that specific connotations of different design strategies should be clearly identified during systematic innovation, for example, "service system design" and "service system design of product" are sometimes different in concept and thus have quite different design methods and evaluation systems, so some design methods determined by designers within their discretion may greatly influence the sustainable effect of practice project. Prudent determinations should be made according to specific situations.

Secondly, design flows are organized at systematic level according to specific design objectives or strategies. For example, an APP developed for a certain project or service is considered as a typical immaterial design, which is "sustainable" as it can reduce resource consumption; however, if each design output requires the development of the corresponding app, it will cause the excessive APPs on the interface and adversely influence use efficiency, so this interactive design is systematically unsustainable. For another example, DFS focuses on the interaction between humans and the whole service process and involves multiple factors, including stakeholders, objects, environment and the complete system flow; it is not targeting "objects" or "environment" alone [3].

Thirdly, in respect of participants in a design project, we emphasize the contributions made by non-professional designers to DFS. The nature of design is to solve problems instead of focusing on "design" itself, so first of all it is required to conduct some surveys in grassroots units to discover problems in China and then design according to specific national conditions [4]; meanwhile, it is required to deliberate on all links in the implementation of a project, cooperate with experts in other fields, get involved in strange fields and dig out the conjunction point between economic benefits and sustainable development. The efforts should also be made to strategically integrate all resources and skills, and hammer out all possibilities for combination of materials, approaches and the market to solve problems that were "unsustainable".

2.3 *Design Being Involved into Social Innovation*

It is generally acknowledged that social innovation is both a process and a result, which is mainly seen in some special social fields such as education, medical treatment, old-age care, poverty reduction, helping the disabled and environmental protection [5], and focuses on change in mode [6]. As defined by the Young Foundation, social innovation is an innovative activity and service aiming at satisfying some certain social needs, mainly promoted and spread by social organizations with the primary goals of sociality [7] Design intervention allows innovation process and results to be more visualized for the convenience of sending and receiving information, thus increasing innovation efficiency; on the other hand, social innovation transforms the role of design from the traditional "visual tool" to "strategy provider", "organizer and coordinator", so that social problems can be innovatively solved in a top-down or bottom-up manner. Consequently, the European design communities believe that design intervention can directly or indirectly improve community relations and social environment and can effectively facilitate social innovation and sustainable development [8]. As a result, "DESIS NETWORK (Design for Social Innovation and Sustainability)", an international network alliance for social innovation and DFS, has been founded to facilitate sustainable social changes led by design [9, 10].

In China, School of Design, Jiangnan University is the first domestic institute to introduce the concept of social innovation to DFS teaching, and have carried out relevant pioneering trials in PSSD (product service system design) to explore a sustainable lifestyle [11]. They worked with DESIS to transform the focus of problems from environment to new lifestyle and mode of sustainable production, ponder on how design can increase the living quality of social vulnerable groups and, by exploring new solutions to "ecological agriculture and healthy food", probe into sustainable coexistence and development of urban-rural relationship. These design projects and trials provide an extensive and complete experience for practice of social innovation in China [11].

In China, the precondition to design intervention is that it must be adapted to indigenous special contexts. In above-mentioned design projects, it is very important to emphasize field survey and lifestyle research, "discover" and "define" problems profoundly through anthropological field investigation. The problems include how to study users' real lifestyle context, analyzing any possible predicament or problems in the lifestyle, how should design be involved, what problems can it solve, etc. Finally, design proposals are generated based on problem analysis in local actual situations.

3 Teaching, Learning and Sharing

DFS will without doubt be one of the main design inclinations in the future. But how should we set relevant curriculum system? How to teach students to effectively learn and apply theories, and popularize model curriculums with good effects as early as possible? I think we should firstly analyze the current situation of teaching.

3.1 Teaching: Curriculum Setting

In China, most universities incorporate sustainability into different design courses as a design theory, and only a small number of schools and colleges have set professional and independent DFS curriculums, which are mostly experiments and trials and having different features from one school to another.

Academy of Arts & Design, Tsinghua University offers undergraduate programme of Sustainable Product Design and postgraduate programme of Theory and Practice of Design for Sustainability at present, in which theoretical development, operating methods and tools of DFS are systematically described so that students can develop the ability to systematically think about and balance the relationships among environment, society, economy and culture, and carry out design practice by using sustainability assessment methods and relevant strategies. In addition, it also offers EMBA programme of Design for Sustainability and Service Innovation and the public course of Design Appreciation, with the former designed to arouse or enhance the sustainable development awareness from business people, while the latter open to all university majors and designed to guide students to evaluate or appreciate design artworks from a sustainable perspective, not in an aesthetic or visual manner.

School of Design, Jiangnan University offers two relevant postgraduate programmes, Product Service System Design and Systematic Innovation and Design Strategy, aimed at constructing such a curriculum system that integrates value creation, product, service and propagation and can achieve the connection between DFS and business innovation. These programmes focus on solving actual social and business problems, and satisfying the demands of sustainable economic development with new information technology. As the result of curriculum, students' works will be delivered to UPA design competition and exhibition, so that the school can check implementation effects of the programmes. Additionally, lectures are organized by the school mostly from the perspective of sustainable business and strategic design, and stress the role of social innovation in supplementing DFS.

School of Design, Hunan University offers more programmes, among which a required course for undergraduates called Product Service System Design aims at applying the DFS concept to business or communities, for which an expert from Danish has been invited to give lectures. In addition, an optional course called Design for Sustainability for Products probes into the development of DFS in terms of materials. Despite of no independent programmes, postgraduate students will participate in investigation and follow-up of sustainable projects in series of workshops, which focuses on design strategies such as PSS (product service system) and Upcycling, so that the school can synchronize DFS teaching with that in Europe.

Based on the experience in cooperation with Polytechnic University of Milan, School of Art and Design, Wuhan University of Technology fulfills systematic design views from perspectives of teaching and practice and offers the optional course called Sustainable System Design for postgraduate students, with their works ranking among the best in 2014 China Universities Industrial Design

Competition. The school also invites domestic and overseas experts in the field of DFS regularly for relevant seminars.

School of Arts & Design, Hubei University of Technology organized its graduation exhibitions in 2013 and 2014 centering on the theme of DFS, and named the two as "Daily Necessities Made of Bamboo" and "Space-saving Home Design" respectively. For the former, bamboo can be made into tools and kitchenware; for the latter, components can be nested, folded and modularized to serve as furnishings. The two propositions allow ideas to become real objects, which are not only exhibitable, but also usable in studios after exhibition, achieving the maximum utilization of products, prolonging service life and rendering "sustainability" to be verified.

3.2 Learning: How to Arouse the Enthusiasm to Learn

In order to increase the understandability of related knowledge and the learnability of design tools, Academy of Arts & Design, Tsinghua University offers SDO (Sustainability Design-orienting Toolkit) teaching software in its programme to guide students to carry out design practice in four stages: ① Discover; ② Define; ③ Develop; and ④ Deliver, so that the students can master systematic and specific evaluation criteria on the premise that they are clearly aware of basic sustainability principles, then develop the design concept in a planned and step-by-step way. The students also need to evaluate the sustainability of each link all the way and finally produce sustainability solutions to specific problems.

To increase effectiveness of courses, School of Design, Jiangnan University has developed a toolkit for relevant case studies. Besides, the school has guided students to carry out design practice in the following three stages: ① Students collect cases and then perform formative template analysis on these cases; each workgroup must carry out two to three case studies before entering the next stage; ② Students make a survey into social hotspots or problems in traditional business transformation around them, and analyze the sustainable opportunities of commercial value contained in these hotspots or problems. ③ Students are assigned with tasks and guided to design interactive APPs or tangible products by using new information carriers and achieve the integration of sustainable services and propaganda. Each stage will end with the solution of some problems.

School of Industrial Design, Guangzhou Academy of Fine Arts does not offer specific courses on sustainability, but teachers will advocate sustainability-oriented design thinking and integrate it into various design practices of students (e.g., design project of bamboo composite products, cooperative project with China Low-carbon Industry Association, etc.) to help students develop "sustainable" values in a subtle way. Meanwhile, it strives to abandon the previous aesthetics-oriented teaching, takes into account hot issues in the course of social reform and focuses on application of new technologies and materials to realize the connection of products, services and interactive design with the market.

College of Design and Innovation, Tongji University emphasizes arousing students' initiative in transforming sustainable designs to sustainable lifestyle. With the project of "Green Campus" as an example, teachers merely guide the overall design direction and teach some basic strategies, while students will combine green products to apply for venture capital fund and then negotiate with young people on network platforms (such as Douban and Taobao), to attract people who are interested and realize the commercial value of sustainable designs. At the meantime, the college also values horizontal cooperation between different disciplines, for example, inspiring students to collaborate with schoolmates from School of Economics and Management on sustainable projects. The reason why the "Green Campus" project succeeds is that it combines the teaching content with students' spontaneous behaviors to get double the result by motivating the initiative of students.

3.3 "Sharing" Initiative: Setting of Parallel Curriculum and Lecturer Mission

Different schools offer different courses, but whatever could solve the problem of sustainable development can be included in DFS, no matter it is green design, ecological design, product service system design or life cycle design. Liu [12] Can we construct a relatively complete DFS teaching system by learning from and taking in advantages in these courses? This will break the location barriers between different schools and groups, help to develop channels for various practices, apply successful experience to demonstration lessons and case studies as early as possible and to the largest extent, and help universities and enterprises make progress in education or commerce.

To achieve the goals above, LeNS-China plans to implement "sharing curriculums" on DFS in different places in the future. Specifically, interscholastic "parallel curriculum" system and "lecturer mission" for DFS are to be constructed to carry out curriculum design in various ways. For example, in respect of curriculum content, schools may assign design themes and projects according to their own situations, which can be the same or different; in respect of faculty, teachers and experts giving lectures on "DFS" in different universities will make up a "lecturer mission"; they will begin and end a class at the same time, exchange views constantly in class and exchange students' homework for evaluation. Seminars on parallel curriculum can be held after the curriculum to increase teaching efficiency. An evaluation system for the curriculum will be established for regular interscholastic teaching assessment. The curriculum structure can be developed by reference to or imitating MOOC to facilitate teaching and correction of homework by the lecturer mission. All of the above will play an active role in promoting DFS teaching. However, the main difficulty in implementation is that these schools have

to negotiate in advance with teachers on class beginning and ending time, so that interscholastically shared courses can be given as scheduled. The initiative of parallel curriculum and lecturer mission may not turn out to be a reality until this problem is solved well.

4 Conclusion

DFS is a long-term practicing process unceasingly seeking for reform, which also indicates that the existing knowledge system is probably imperfect or not suitable for national conditions in China. The domestic design society has to make more attempts and think deeply about how to put "virtual" theories into practice, make a summary of rules and laws in the verification of theories and teach practical design methods to students. Precisely because the knowledge system is dynamically developing, it is not only necessary, but also inevitable to "share" successful experience in various ways. As a result, in order to achieve the practice of sustainability theories more effectively, further research will focus on how to fully exploit and utilize information platforms like LeNS-China and construct "sustainability" assessment criteria suitable for China, so as to we can provide practical and specific guidance for practice in China.

References

1. Shedroff, N.: Rethinking of Design: Strategies and Practices on Design for Sustainability (trans: Liu, X., Qin, J.), pp. 4–5. Tsinghua University Press, Beijing (2011)
2. Zhang, L., Ni, M., Jia, L.: Systematic innovation-oriented research on service design strategies for supermarkets. J. Packag. Eng. **35**(12), 66–69, 79 (2014)
3. Yu, L., Li, B.: Research on product service design from the perspective of sustainability. J. Packag. Eng. **32**(20), 73–76 (2011)
4. Jiang, Y., Zhang, Q.: Theoretic Observation on Design for Sustainability. N. China Construction News (2014)
5. He, Z.: Ten Theoretical issues on social innovation. J. Marx. Real. 99–112(2011)
6. Fu, T.: Social Innovators Concerning to Change the Pattern, Not A Single Transaction: An Interview with Bill Drayton (trans: Zong, Z.), vol. 53, pp. 5–11. Beijing Civil Society Development Research Center, China Development Brief, Intellectual Property Publishing House, Beijing (2012)
7. Miaosen, G.: Wellbeing, lifestyle and social innovation: strategic design for sustainable society. J. Art Des. **203**(03), 123–124 (2010)
8. Linghao, Z., Xiaofan, J.: On Strategies for the inheritance and development of Yangzhou's Lacquerware industry from the perspective of technical fashion. J. Creat. Des. **30**(01), 65–07 (2014)
9. Manzini, E., Penin, L., Yongqi, L., et al.: DESIS international network: design for social innovation and sustainability (trans: Zhang, Z.). J. Creat. Des. **09**(04), 004–013 (2010)

10. Manzini, E.: DESIS statement—design as the agent of sustainable changes (trans: Gong, M.). J. Creat. Des. **09**(04), 048 (2010)
11. Gong, M.: Design for Chinese social innovation—pilot PSS design experiences for sustainable lifestyles (trans: Xie, C., Dong, Y.). J. Creat. Des. **16**(05), 018–023 (2011)
12. Liu, X.: The notion, evolution and practices of sustainable design. J. Creat. Des. **07**(02), 36–39 (2010)

Building a Disaster Recovery Framework for e-Learning Environment Using Disaster Information and Inter-cloud Computing

Satoshi Togawa and Kazuhide Kanenishi

Abstract In this research, we have built a framework of disaster recovery against earthquake, tsunami and massive flood for e-Learning environment. This framework is constructed by private cloud environment and inter-cloud infrastructure. And, this framework uses a disaster information such as disaster emergency alert for selecting the target of live migration destination. We build a prototype system that is constructed by several private cloud fabric on each site such as several universities. In addition, this framework can grasp the emergency alert information via smartphone and cellphone carrier. We show the configuration of prototype system. Then, we show the experimental results on the prototype system.

Keywords Disaster recovery · e-Learning environment · Private cloud collaboration · Emergency alert collection

1 Introduction

On March 11, 2011, a major earthquake attacked to Eastern Japan. Especially, the huge tsunami that is generated by major earthquake attacks an east coast of Eastern Japan. In Shikoku area including our universities in Western Japan, it is predicted that Nankai earthquake will happen in the near future. There is an interval theory that occurs every 100–150 years on the Pacific side in Western Japan. Nankai earthquake has high occurrence rate that is between 70 and 80 % in the next 30 years. We have prepare the disaster for the major earthquake.

S. Togawa (✉)
Education Center for Information Processing, Shikoku University,
123-1 Furukawa Ojin-Cho, Tokushima 771-1192, Japan
e-mail: doors@shikoku-u.ac.jp

K. Kanenishi
Center for University Extention, Tokushima University, 2-1 Minami-Josanjima,
Tokushima 770-8506, Japan
e-mail: marukin@cue.tokushima-u.ac.jp

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In addition, we also have many bad experiences that are sudden serious disaster over the past few years. For example, the large residential area of Hiroshima city in Western Japan had damaged by huge mudslides. The short period rainfall makes this mudslide at August 2014. On September 11, 2015, Joso city of Ibaraki prefecture had damaged by massive flood by concentrated heavy rain. It has the flooded land area of about 40 km^2. Moreover, the seven stations of railway were swamped by deep floods at Joso city. This is not uncommon story their serious disasters such as massive flood and concentrated heavy rain in these days. It is no longer special for us to suffer from disasters very often. We think the preparing for these disasters including these massive floods is very important for keeping our life, and it is very important for the information system's field.

On the other hand, the informatization of educational environment on universities is rapidly progressed by evolutional information technology in Japan. Current education environment cannot be realized without educational assistance system, such as LMS (Learning Management System), learning and teaching ePortfolio, and so on. The learning history of students is stored by these educational assistance systems. The fact is that awareness of the importance of learning data such as learning histories and teaching histories. Today's educational environment on universities depends on educational assistance system with information technology infrastructure. If the educational assistance system with students learning history is lost by natural disasters, we think it become equivalent to lost sustainability for educational activity. Today's universities educational activity cannot continue smoothly without those learning data and assistance system.

Thus, we have built a framework of disaster recovery for e-Learning environment [1]. This disaster recovery framework is based on inter-cloud platform over the educational consortium that is organized with some universities. Each university which is organized as to be able to work for educational consortium has a private cloud fabric for keeping own e-Learning environment within their virtual machines. These organized private cloud fabrics are functioned as one large private cloud platform.

We can find applications for constructing information system infrastructure by the private cloud for academic field such as Yokoyama's study [2]. The target of this study is to provide massively parallel computing such as Apache Hadoop environment. Next, Takano's study provides a virtual machine migration mechanism and describing their live migration environment [3]. This study treats the mechanism of virtual machine migration with virtual machine monitor. However, the method of this study provides to use computer resources effectively. These are different purpose for disaster recovery. Especially, it is not decided live migration destination with selecting safer destination of countermeasures against disaster and disaster recovery.

In this research, we have built a framework of disaster recovery from large-scale disaster such as earthquake, tsunami and massive flood for e-Learning environment. We build the private cloud computing fabrics and this inter-cloud environment, and our target is to build the private cloud collaboration framework. This private cloud environment and inter-cloud platform are constructed any private cloud fabrics with

the distributed storage system into several organizations such as universities. The Learning Management System such as Moodle [4] build on several private cloud fabrics. Each VM (Virtual Machine) has a LMS and the related data with a SQL database. General IaaS (Infrastructure as a Service) platform such as Linux KVM (Kernel-based Virtual Machine) [5] has a live-migration function with network shared storage and Virtual Machine Manager [6]. General network shared storage is constructed by iSCSI, NFS and usual network attached storage system. These network shared storage systems are bound to any physical storages on the each organizations. Therefore, it is difficult to do the live-migration of VMs between inter-organizations.

Our prototype platform is built with distributed storage system and KVM based IaaS architecture on many usual server machines with network interfaces. It is able to handle many VMs including LMS and the data with enough redundancy. In addition, this proto-type platform will operate inter-organizations. Thus, our prototype platform will be able to operate integrative each organization's private cloud fabric. If one organization's e-Learning environment on the private fabric is lost by some disaster, it will be able to keep running same environment on other organizations environment.

In addition, proposed framework has an algorithm for deciding the live-migration destination. If some live-migration destination have a high risk of the affected by a disaster, we cannot select these destinations for live-migration destination. Because, we must avoid the risk of spoilage for migrated e-Learning environment. Therefore, we have to measure the risk that is affected by a disaster for each live-migration destination. Then, we have to select the lowest risk destination for live-migration as much as possible.

In this paper, we propose a private cloud collaboration framework between private cloud fabrics on several organizations, and we show a configuration of proposed prototype system. And, we show the results of experimental use and examine these results. Finally, we describe future study and conclusions.

2 Disaster Recovery Framework for e-Learning Environment

In this section, we describe the private cloud collaboration framework for e-Learning environment. Especially, the purpose of this framework is a disaster recovery for LMS such as Moodle, and keep running LMS and related data. Figure 1 shows a framework of disaster recovery assistance for the e-Learning environment. Each organization such as university has each private cloud fabric. Each private cloud fabric has several server hardware at least four machines to get enough fabric's redundancy, and network connections between several server hardware. Each node server does not independent other node server on the private cloud fabric.

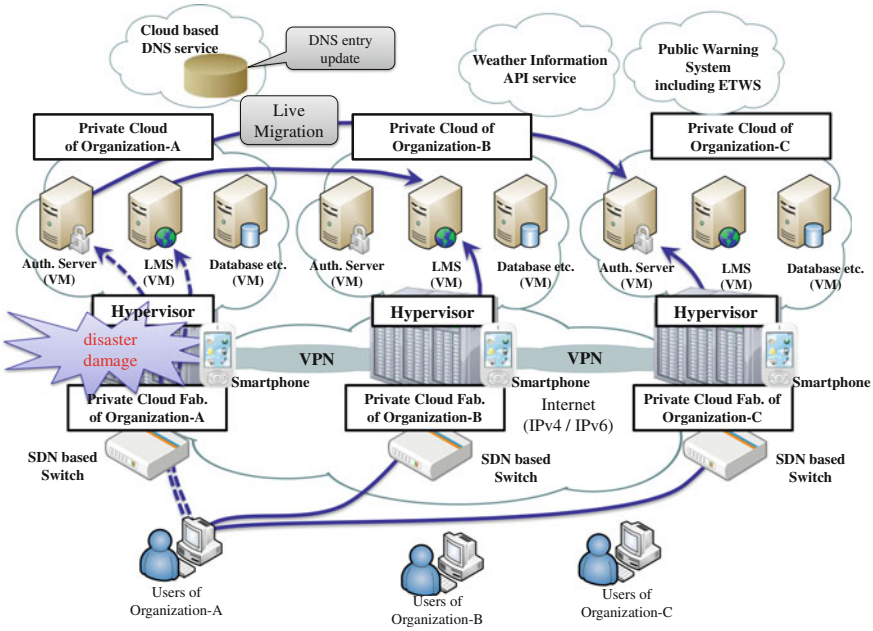


Fig. 1 Framework of disaster recovery assistance

They provide computing resources and data store resources via VMs. Each VM that exists on the private cloud fabric is generated from the resources in the private cloud fabric. It is able to process any function such as authentication and LMS function on the VM. In addition, Each VM can migrate between other private cloud fabrics, and it is able to continue to keep processing. A live migration function needs a shared file system to do the VM's migration. The product of Sheepdog Project [7] is applied to proposed framework. Sheepdog distributed storage system provides highly available block level storage volumes via QEMU based VMs. Sheepdog based distributed storage system does not have a single point of failure. Because, Sheepdog has a fully symmetric architecture, and this architecture does not have a meta-data server for managing the position of data store. If some node hardware that compose Sheepdog cluster, it has small risk to lost the VM image file. Moreover, each VM image is able to find other organization's private cloud fabric. The several organization's private cloud fabrics construct integrally storage system by Sheepdog based distributed storage. It can be able to reboot affected VMs on the other organization's private cloud fabric under the disaster situation.

Today's general smartphone has a function, which catch the disaster alert notification. Personal Warning System (PWS) including Earthquake and Tsunami Warning System (ETWS) delivers disaster alert notification over the cell-phone carrier. Customized smartphone passes alert notification makes live-migration

command for controlled VMs. As a result, proposed disaster recovery framework can make a treat adaptively VMs live-migration between private cloud fabrics. Each organization's e-Learning environment will get a sustainability under the disaster situation by proposed disaster recovery framework.

3 Deciding Live Migration Destination Using Disaster Information

The live-migration function for VMs that drives e-Learning environment such as LMS is effective for against natural disaster. Proposed disaster recovery framework based on the server and infrastructure virtualization technology is very useful for keep running educational assistance system on universities. However, the live-migration target selection under the disaster situation is important. Especially, a destination selecting policy is very important for Business Contingency Plan, and Business Continuity Plan. If one private cloud fabric of live-migration destination has a high probability of suffering damages by the disaster, it is not good decision to take destination for live-migration. Therefore, we think the measurement a probability of suffering damages by natural disaster is very important. If we can grasp the probability of suffering damages for each live-migration destination, proposed framework decides the safest destination of live-migration.

Figure 2 shows a collecting flow of the disaster information. Especially, this collecting sequence shows the collecting method for the earthquake warning and rainfall amount. Japan Meteorological Agency (JMA) collects seismic wave signals from many earthquake observation points. Then, JMA generates an earthquake warning immediately after the seismic wave signals is grasped by earthquake observation system. In addition, JMA has many observation points for measuring rainfall amount. Of cause, JMA provides any weather information, and makes some weather warning based on observation data such as concentrated heavy rain, huge flood and strong window. However, this warning area is too large area for our purpose. Therefore, we take the rainfall amount from weather information service.

The weather information service such as Yahoo developer network pro-vides pinpoint rainfall amount based on latitude and longitude. It is able to collect easily pinpoint rainfall amount. The request is made by provided weather API. And, the re-turned rainfall amount is 7 entries. There are one observation amount and six forecast data. As a result, we can make an easily forecasting of rainfall amount in one hour. It is possible to escape from acquiring the disaster of huge flood.

When the disaster type is an earthquake, the private cloud fabric that is received earthquake warning is starting the check sequence of other private cloud fabrics. If the other private cloud fabric has the same or similar earthquake warning, the framework deselects that private cloud fabric from the candidate destinations. Then, the earthquake warning received private cloud fabrics makes the live-migration command for own VMs to migrate other safer private cloud fabrics. The earthquake

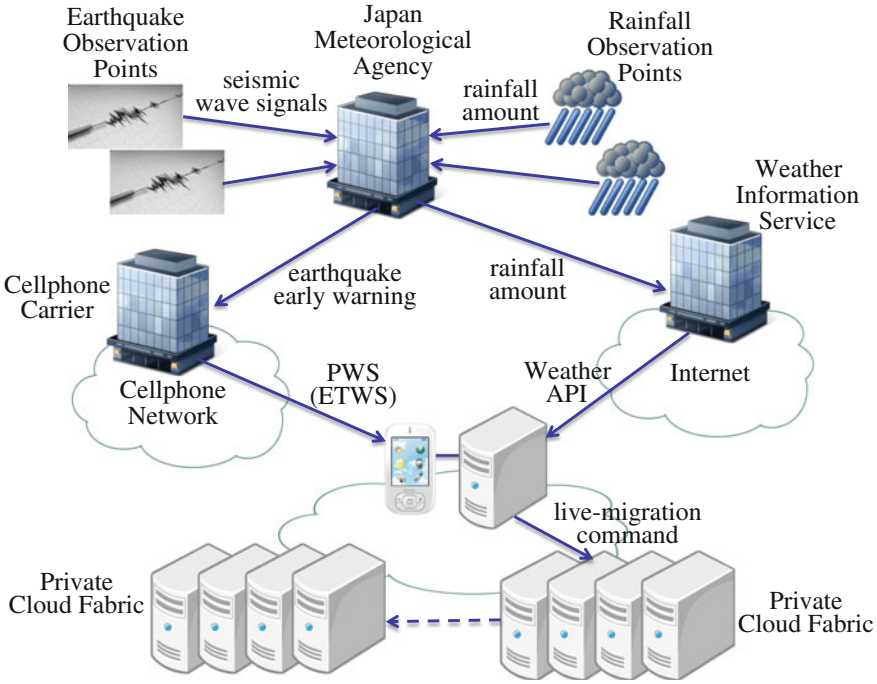


Fig. 2 Collecting flow of the disaster information

warning which sends via Earthquake Early Warning System is managed by only JMA. Therefore, we can trust the earthquake warning which is received from cellphone carrier via PWS including ETWS.

On the other hand, we take a double judgement for case of massive flood. At first, the private cloud fabric which is received the evacuation advisory is starting the check sequence of other private cloud fabrics. If the other private cloud fabric has the same or similar evacuation advisory, the framework deselects that private cloud fabric from the candidate destinations. Next, the framework checks the rainfall amount of candidate destinations. If one of the candidate destination has many amount of rainfall, proposed framework decides also deselection the high potential private cloud fabric from the candidate destinations. As a result, we can take safer live-migration destination by this selecting method.

4 Experimental Use and Results

Proposed framework was tested to confirm its effectiveness. We made the prototype private cloud fabrics, and made the virtual disk images and virtual machines configuration on the prototype system. Several VMs was installed LMS such as

Moodle. Each size of the virtual disk images is 40 GB, and each size of allocated system memory is 8 GB on this experimental use. Table 1 presents the node hardware specification of the private cloud fabrics, and Table 2 presents the Private Cloud Collaboration Controller specification.

The prototype of the private cloud fabrics are constructed by 12 node machines and each node has 250 GB capacity HDD. A total amount of physical HDD capacity is about 3.0 TB. Each clustered node uses about 4.0 GB capacities for the hypervisor function with an operating system. This amount is ignorable small capacity. However, the distributed storage system has triple redundancy with default configuration for this experimental use. As a result, we can use about 1.0 TB storage capacity of the distributed storage system can extend to add other node machines, exchange to larger capacity HDDs, and taking both solutions. We can take enough scalability and redundancy by this distributed storage system.

We tried to do a live-migration in prototype system using collected information such as earthquake alert via PWS, and amount of rainfall from weather information via Weather API. However, this earthquake alert in this experimental use is emulation message. Because, it is difficult to get the real earthquake alert in the short period. We tried this experimental use by ten times. The live-migration operation was completely controlled by proposed disaster recovery framework under this test scenario. Especially, the safest live-migration destination was selected under the experimental use.

Table 3 shows the time of live-migration for experimental use. We used the operate VM's live-migration by the interface of Virtual Machine Manager. The time of live-migration for same private cloud fabric is 25.3 s. The time of live-migration for inter-private cloud fabrics is 27.0 s. We think that both experimental times is enough live-migration time for a disaster reduction of provided VMs. Moreover, proposed disaster recovery framework make successful results with active condition. The live-migration of these experimental use is operated by private cloud collaboration controller, and this live-migration function was triggered by

Table 1 Hardware specification of the private cloud nodes

Elements	Specification
CPU	AMD Opteron 3250HE Quad Core
System Memory Capacity	16.0 GB
HDD Capacity	250 GB with SATA 600 interface
Operating System	Ubuntu Server 16.04 64 bit ed. Daily Build

Table 2 Hardware specification of the private cloud collaboration controller

Elements	Specification
CPU	AMD Opteron 3250HE Quad Core
System Memory Capacity	16.0 GB
HDD Capacity	250 GB with SATA 600 interface
Operating System	Ubuntu Server 14.04.3 LTS 64 bit ed.

Table 3 Live migration times of this experimental trial

Test case	Time of live migration (s)
VM moves between same private cloud nodes	25.3
VM moves between inter private cloud nodes	27.0

customized Android based smartphone. We think this experimental use is good; the time requirement for VMs migrating was a short period. However, the results were getting under the initial condition. The VM that are made heavy use of LMS has large size of virtual disk image. Therefore, the time of live-migration will needed more than initial condition. We think we have to make the experimental use under the actual condition.

5 Conclusion

In this paper, we proposed a framework of disaster recovery for e-Learning environment. Especially, we described an assistance to use a proposed framework, and we show the importance of an against the earthquake and tsunami disaster for e-Learning environment. We built the prototype system based on proposed disaster recovery framework, and we described a system configuration of the prototype system. We explained the results of experimental use and examine. For the future, we will try to test the cloud computing orchestration framework such as OpenStack. And, we will try to experiment confirming its effectiveness under the integrated cloud environment such as private cloud and public cloud.

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References

1. Satoshi, T., Kazuhide, K.: Disaster Recovery Framework for e-Learning Environment using Private Cloud Collaboration and Emergency Alerts. In: Proceedings of HCII2015, LNCS 9133, pp. 588–596. Springer, Heidelberg (2015)
2. Yokoyama, S., et al.: A proposal of academic community cloud architecture and its evaluation. IPSJ J. **54**(2), 688–698 (2013)
3. Takano, R., et al.: Cooperative VM migration: a symbiotic virtualization mechanism by leveraging the guest OS knowledge. IEICE Trans. Inf. Syst. **E96-D**(12), 2675–2683 (2013)
4. Moodle Official Web Site. http://moodle.org
5. Linux KVM Official Web Site. http://www.linux-kvm.org
6. Virtual Machine Manager Official Web Site. http://virt-manager.org
7. Sheepdog Project Web Site. http://www.osrg.net/sheepdog/

Research and Implementation on Fitness Management System for Hubei Province Public Servants

Qi Luo

Abstract Public servant is a special group which is under high tension because of their life style, rest and work system and with high pressure coming from jobs and society. Public servant is in sub-health status and is high dangerous group of some chronics. Public servant has a highly recognition about the value of sport for health and has desire to participate in it. But because some objective and subjective reasons, public servant cannot participate in exercise and is lack of targeted and scientific. From the needs of scientific guidance for Public servant' physical exercise and base on the fitness index, medical index and daily behaviors, The Fitness Management System for Hubei Province Public Servants in China was designed. The system consists of 4 subsystems such as exercise prescription subsystem, nutrition prescription subsystem, psychological control subsystem and lifestyle subsystem. The system provides a scientific support platform for exercise health promotion of Hubei Province Public servants. Moreover, it can effectively guide them to exercise scientifically and thus improving their physical health.

Keywords Public servants · Fitness management system · Physical health · Hubei province

1 Introduction

Public servant is a special group which is under high tension because of their life style, rest and work system and with high pressure coming from jobs and society. Public servant is in sub-health status and is high dangerous group of some chronics.

Q. Luo (✉)
College of Sports Engineering and Information Technology,
Wuhan Sports University, Wuhan 430079, China
e-mail: ccnu_luo2008@126.com

Q. Luo
School of Educational Information Technology,
Central China Normal University, Wuhan 430079, China

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Public servant has a highly recognition about the value of sport for health and has desire to participate in it. But because some objective and subjective reasons, public servant cannot participate in exercise and is lack of targeted and scientific [1, 2].

A large number of studies have shown that the health condition of the Public servant is worrying and their physique is on a declining trend and in a typical sub-health state, with the characteristics of three-high and one-low and overweight. As the Public servant involves prosperity, thriving and stability of the state, study on their health condition admits of no delay. China's national conditions such as the 4-2-1 problem caused by the family planning, heavy free medical care burden of the Public servant as well as the cure to prevention policy proposed in the National Outlines for Medium and Long-term Planning for Scientific and Technological Development (2006–2020) agree with the current trend of health management philosophy. Therefore, to build a Fitness Management System applicable to China's Public servant under the health management philosophy has important guiding and practical significance [3–5].

2 Health

Health is the level of functional or metabolic efficiency of a living organism. In humans it is the ability of individuals or communities to adapt and self-manage when facing physical, mental or social challenges. The World Health Organization (WHO) defined health in its broader sense in its 1948 constitution as a state of complete physical, mental, and social well-being and not merely the absence of disease or infirmity. This definition has been subject to controversy, in particular as lacking operational value and because of the problem created by use of the word "complete" Other definitions have been proposed, among which a recent definition that correlates health and personal satisfaction. Classification systems such as the WHO Family of International Classifications, including the International Classification of Functioning, Disability and Health (ICF) and the International Classification of Diseases (ICD), are commonly used to define and measure the components of health. Health is that balanced condition of the living organism in which the integral, harmonious performance of the vital functions tends to the preservation of the organism and the normal development of the individual.

Systematic activities to prevent or cure health problems and promote good health in humans are undertaken by health care providers. Applications with regard to animal health are covered by the veterinary sciences. The term healthy is also widely used in the context of many types of non-living organizations and their impacts for the benefit of humans, such as in the sense of healthy communities, healthy cities or healthy environments. In addition to health care interventions and a person's surroundings, a number of other factors are known to influence the health status of individuals, including their background, lifestyle, and economic, social conditions, and spirituality; these are referred to as determinants of health. Studies have shown that high levels of stress can affect human health.

Generally, the context in which an individual lives is of great importance for both his health status and quality of their life. It is increasingly recognized that health is maintained and improved not only through the advancement and application of health science, but also through the efforts and intelligent lifestyle choices of the individual and society. According to the World Health Organization, the main determinants of health include the social and economic environment, the physical environment, and the person's individual characteristics and behaviors.

More specifically, key factors that have been found to influence whether people are healthy or unhealthy include the following:

- Income and social status
- Social support networks
- Education and literacy
- Employment/working conditions
- Social environments
- Physical environments
- Personal health practices and coping skills
- Healthy child development
- Biology and genetics
- Health care services
- Gender
- Culture

Donald Henderson as part of the CDC's smallpox eradication team in 1966. An increasing number of studies and reports from different organizations and contexts examine the linkages between health and different factors, including lifestyles, environments, health care organization, and health policy—such as the 1974 Lalonde report from Canada; the Alameda County Study in California; and the series of World Health Reports of the World Health Organization, which focuses on global health issues including access to health care and improving public health outcomes, especially in developing countries.

The concept of the health field, as distinct from medical care, emerged from the Lalonde report from Canada. The report identified three interdependent fields as key determinants of an individual's health. These are:

Lifestyle: the aggregation of personal decisions (i.e., over which the individual has control) that can be said to contribute to, or cause, illness or death;

Environmental: all matters related to health external to the human body and over which the individual has little or no control;

Biomedical: all aspects of health, physical and mental, developed within the human body as influenced by genetic make-up.

The maintenance and promotion of health is achieved through different combination of physical, mental, and social well-being, together sometimes referred to as the health triangle. The WHO's 1986 Ottawa Charter for Health Promotion further stated that health is not just a state, but also a resource for everyday life, not

the objective of living. Health is a positive concept emphasizing social and personal resources, as well as physical capacities.

Focusing more on lifestyle issues and their relationships with functional health, data from the Alameda County Study suggested that people can improve their health via exercise, enough sleep, maintaining a healthy body weight, limiting alcohol use, and avoiding smoking. Health and illness can co-exist, as even people with multiple chronic diseases or terminal illnesses can consider themselves healthy.

The environment is often cited as an important factor influencing the health status of individuals. This includes characteristics of the natural environment, the built environment, and the social environment. Factors such as clean water and air, adequate housing, and safe communities and roads all have been found to contribute to good health, especially to the health of infants and children. Some studies have shown that a lack of neighborhood recreational spaces including natural environment leads to lower levels of personal satisfaction and higher levels of obesity, linked to lower overall health and well being This suggests that the positive health benefits of natural space in urban neighborhoods should be taken into account in public policy and land use.

Genetics, or inherited traits from parents, also play a role in determining the health status of individuals and populations. This can encompass both the predisposition to certain diseases and health conditions, as well as the habits and behaviors individuals develop through the lifestyle of their families. For example, genetics may play a role in the manner in which people cope with stress, either mental, emotional or physical. For example, obesity is a very large problem in the United States that contributes to bad mental health and causes stress in a lot of people's lives (One difficulty is the issue raised by the debate over the relative strengths of genetics and other factors; interactions between genetics and environment may be of particular importance.).

3 System Functional Frame

The system functional frame consists of the following four subsystems, exercise prescription subsystem, nutrition prescription subsystem, mental control subsystem, and lifestyle control subsystem, the system structure is Fig. 1.

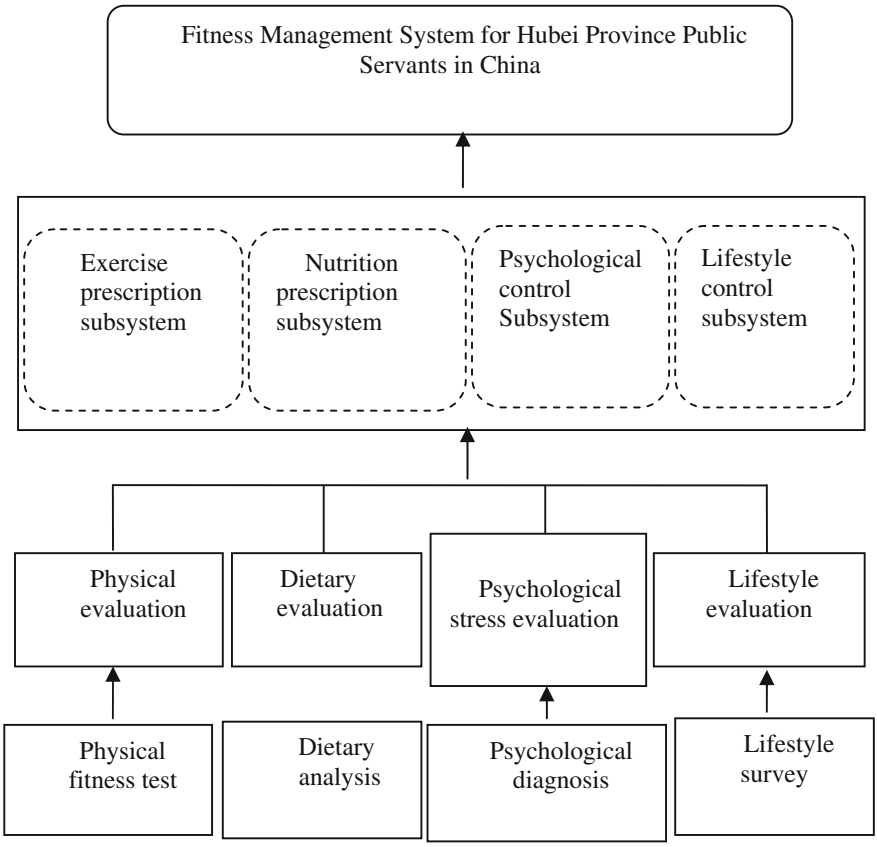


Fig. 1 System functional frame of fitness management system for hubei province public servants in China

4 System Components

4.1 Exercise Prescription Subsystem

Test the body shape, body function and basic data of physical health quality; focus the analysis and evaluation on the physical test data, the Public servants' bone density, blood glucose, blood lipids, cardiopulmonary endurance and lower-limb explosive strength; study and formulate personalized physical health promotion exercise prescription according to the Public servants' fitness testing, analysis and evaluation.

4.2 Nutrition Prescription Subsystem

It adopts the three-dimensional food model, applies 24 h recall method to record 3–5 d diet, and makes nutritional analysis with the dietary analyzing software. Evaluate the total caloric intake of 3 meals, and compare with the recommended amount for such group to establish reasonable adjustment plans. Study the dietary catering of corresponding energy; assess the degree of the nutrition improvement before and after the intervention. To make detailed evaluation, and evaluate protein nutritional status, vitamin A, D and iron, zinc and other indicators through the body composition, hemoglobin and serum related nutrition indicators.

4.3 Mental Control Subsystem

Research and analyze the Public servants' psychological stress characteristics in different genders, grades and ages through the diagnostic questionnaire on their psychological stress characteristics. Use the psychological stress evaluation questionnaire to analyze the characteristics of the psychological status of Public servants, and to establish the psychological stress evaluation norm. Select appropriate mental control methods and means, and establish personalized Public servants psychological control scheme according to the different levels of psychological stress classification.

4.4 Lifestyle Control Subsystem

Lifestyle control subsystem studies the Public servants' lifestyles, and analyzes their lifestyle characteristics and the differences of Public servants' lifestyles in different genders, ages and grades. Establish a healthy lifestyle mode from the perspective of biological-mental-social medicine mode. Study and formulate personalized lifestyle control plans by using the Public servants healthy lifestyle mode and evaluation system.

5 Structure of Fitness Management System for Hubei Province Public Servants in China

The whole system is constructed by 3 levels, which includes the resource level, the resource management level and the human-machine interaction level, see Fig. 2. In terms of the levels: the resource level mainly consists of the database, the knowledge base, the rule base and the model base; the resource management level is

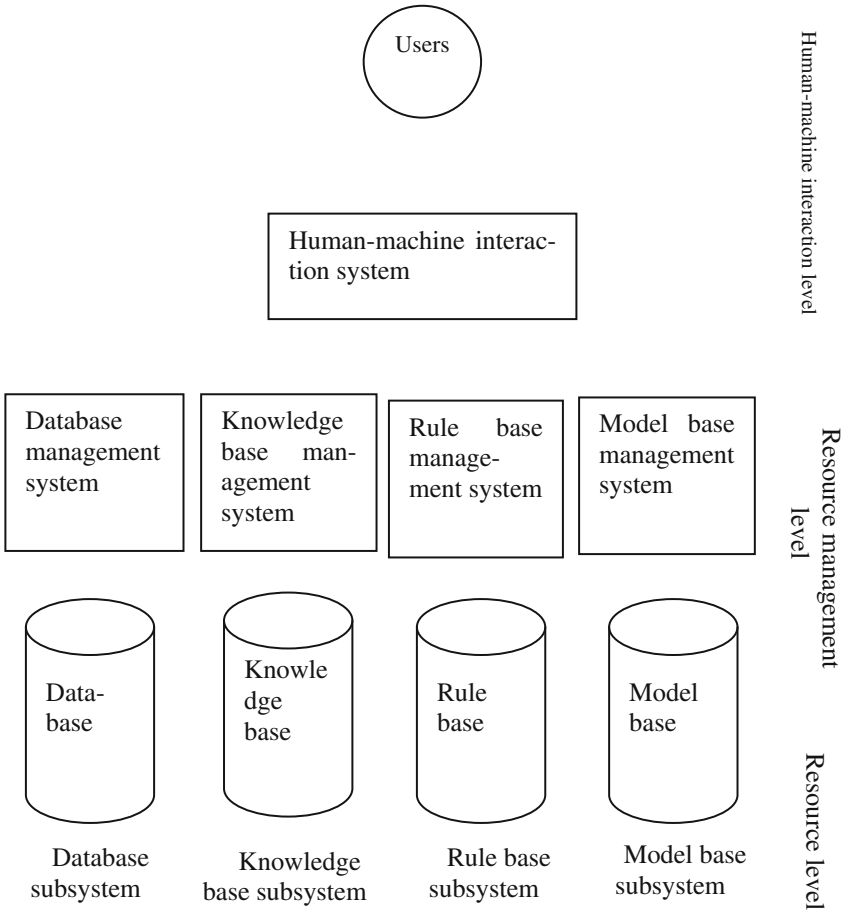


Fig. 2 System structure of fitness management system for hubei province public servants in China

composed of the management systems of the four bases, and all management systems are interlinked to conveniently call the resources accurately, reasonably; the human-machine level realizes the direct dialog of the user and the system. In terms of the constitute elements of the system, the system consists of the database subsystem, the knowledge base subsystem, the rule base subsystem, and the model base subsystem these four major subsystems.

6 System Prescription

Prescription is an important part of the system study, and the prescription output by this system can directly guide the Public servants. The system prescription includes the quantitative prescription and the qualitative prescription. And the quantitative prescription includes the exercise prescription and the nutrition prescription. The qualitative prescription includes the psychology prescription and the lifestyle prescription.

The greatest characteristic of the exercise prescription is targeted to improve individual physical fitness. In the process of researching and developing the exercise prescription: the first thing is to understand the Public servants' individual physical conditions; then carry on the related exercise ability tests; at last, choose the appropriate exercise programs, exercise intensity, duration, exercise frequency and the prescription duration according to the evaluation results of the exercise ability tests. What calls for attention is that exercise is the inducing factor of certain diseases. When make the exercise prescription, it's needed to consider the person's related medical examination results to eliminate the risk of exercise reduced diseases.

6.1 Confirm the Index System

According to the investigation and relevant literature research of the physical conditions of Public servants, medical health inspection Chad, chronic disease, research and collect relevant data from the physical tests, chronic medical examination and investigation three aspects. This is the information basis of generating the exercise prescription. Physical test information: on the basis of "the National Physique Health Standard", direct at the job nature and physical health of the Public servants, and target to increase the corresponding fitness indicators, See Table 1.

Table 1 The indicator of Public servants' fitness

First class indicator	Second class indicator	Third class indicator
	Body shape	Body fat percentage, BMI, waistline
Body Constitution	Physiological function	Systolic pressure, diastolic pressure, VO2max, vital capacity, heart rate
	Physical fitness	Left hand grip strength, right hand grip strength, 1 min sit-ups, sit-and-reach, one foot standing with eyes closed, reaction time, lower-limb explosive strength

Medical monitoring information: Public servants are high-risk group of cardiovascular, metabolic chronic diseases, so take blood glucose, blood lipid (total cholesterol, triglyceride, low density lipoprotein cholesterol, high-density lipoprotein) and bone mineral density into the health evaluation system as the basis for exercise prescription.

Promote the knowledge acquisition system to collect the index data through the self-developed Public servants physical fitness service. There may be a large number of dirty data into the database, and the missing data, wrong grammar, duplicate records, and ambiguous data etc. are the sources of "dirty" data. The "dirty" data will have a great impact on the information support provided by the decision analysis system. Therefore, it's needed to clean the dirty data first and then load data again. Data loading is the process of loading the cleaned data to the database. The data loading way is connected with the extraction of raw data and the storage way of the switched data [6, 7].

6.2 Decision-Making Inference Technology

S represents Index information, H represents physical evaluation result, and F represents exercise prescription. Based on the state of S, W, and through knowledge acquisition, F selects the appropriate model to make inference, and analyzes the results to make a scientific and rational decision-making program. That is, F = f(S, H); and S represents the index information of Public servants, H represents the physical evaluation result.

In the process of decision-making and doing inference, the decision inference engine is the key part of the whole decision-making model. It not only relies on the inference method, it relies more on the inference control strategy [8, 9]. The inference method is knowledge application model, and inference control is reasonable knowledge choice. Inference control directly decides the effect and efficiency of making inference, and the inference control strategy is the core of inference control. Inference control strategy is to prevent the endless inference process, or to prevent that the inference process is too long to increase the complexity of time and space, and so to limit the depth, width, time, space and so on. The system mainly uses the production type knowledge representation and frame type knowledge representation; and it mainly uses the forward making inference. The inference control strategy is shown in Fig. 3.

6.3 Prescription Generation

Use the modeling method of object-oriented knowledge representation framework to build the exercise prescription model base for different physical conditions, which includes the cardiopulmonary function improving model, the weight losing

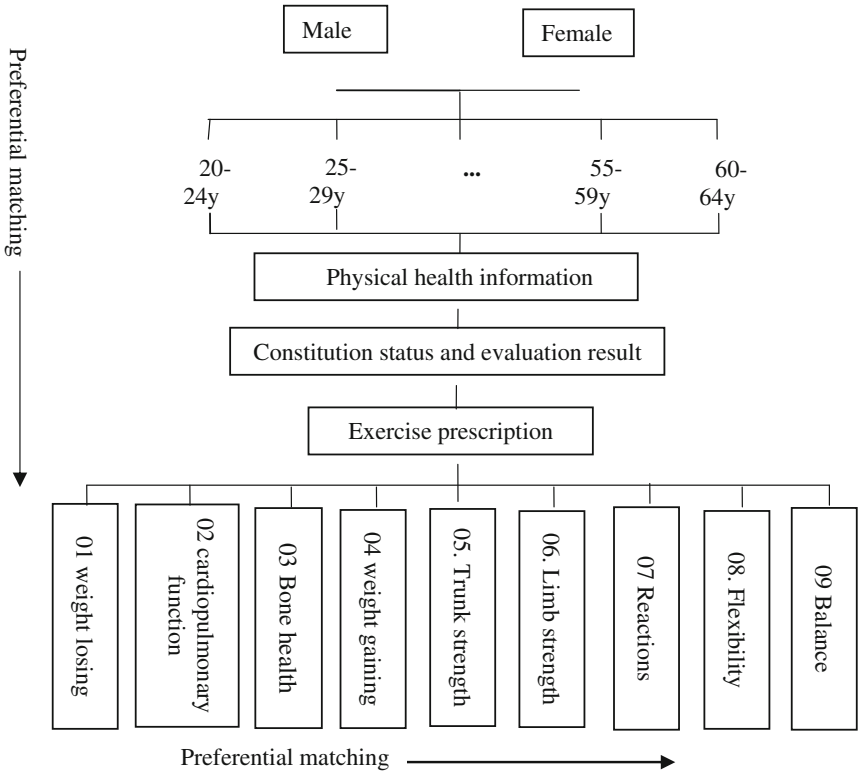


Fig. 3 Inferential controlled strategy of system knowledge

model, the bone health model, the weight gaining model, the trunk strength model, the limb strength model, the reaction model, the flexibility model and the balance model [10, 11].

7 Conclusion

Start from the demand of scientific exercise guide of the public servants to design Fitness Management System for Hubei Province Public Servants in China. This system gathers the database, the knowledge base, the model base and the rule base. It provides a scientific exercise health promotion platform for public servants in different ages, genders and physical conditions. Also it realizes the decision support system for public servants' health promotion which combines the exercise prescription, nutrition prescription, psychological control and lifestyle control. And it provides guides and decision support for improving Public servants' physical health.

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References

1. Zhao, F., Liu, M., Wan, G., et al.: Survey on the overweight, obesity status and lifestyle among public servants in Beijing city. Chin. J. Health Educ. **27**(2), 87–90 (2011)
2. Wen, Z., Wang, M.: Health quality is the foundation of the public servants' comprehensive and harmonious development. Chin. Public Adm. (10), 25–27 (2008)
3. Ma, J., Li, S., He, X.: Survey on health promoting lifestyle of white collars and counter measures. Chin. Gen. Pract. **14**(3), 788–790 2011
4. Anhui administrative institute of investigation: Middle-aged public servants suffered health crisis. Decis. Making **2**, 46–48 (2010)
5. Xiong, Y., Zhang, Y., Chen, X., et al.: Design and application of management and analysis system of diving training data. Sport Sci. **24**(10), 41–42 (2004)
6. Wei, B., Li, H.: The design and implementation of information management system of professional sports teams. Sport Sci. **24**(3), 20–23 (2004)
7. Dong-sheng, M.: Essentials of System Science, pp. 298–312. China Renmin University Press, Beijing (2006)
8. Hong-shen, G.: Decision Support System-Theory, Methods and Cases, pp. 22–58. Tsinghua University Press, Beijing (2005)
9. Yang, S.: Intelligent Decision Making and Intelligent Decision Support, pp. 89–130. Science Press, Beijing (2005)
10. Wu, W., Yu, L:. Construction of decision supporting system for monitoring function in sports traing. J. Shanghai Univ. Sport **31**(5), 55–59 (2007)
11. Sun, Y., Ning, S., Lu, M., et al.: OLAP and data mining technology in decision supporting system for Chinese traditional medical diagnosis. Comput. Eng. **32**(9), 251–252 (2006)

Introduction to Education 3.0 Through the Use of Technological Tools for the Teaching of Arts in Preschool

Luz Nery Janamejoy and Sanin Ortiz

Abstract The glimpse of the future education warns the massive involvement of technology in the learning process, which must be aligned and re-think the dynamics of teaching art with technology. This study compares the use of digital tablets and the traditional way of teaching, examining the attitude and the learning outcomes of children, measured by the method of observational analysis and the Likert scale questionnaire revealing advantages and disadvantages, ways to proceed, possibilities and the significant differences for each method of education.

Keywords Education 3.0 · Arts in preschool · Technology in education · Web 3.0

1 Introduction

The internet and technology has introduced new ways in which we establish socio-communicative relationships, and it has been interjected into educational contexts which has facilitated new ways of understanding art and science, culture and society, as well as teaching and teaching methods [1]. A new dynamic is created where the teacher will have the unique role of being a leader in the use of technologies to make education more useful and enjoyable, and to promote the values of human coexistence. Because technology is part of everyday social life, the teacher must prepare for new learning environments that work around the resulting attitudes and behaviors, and act on that every day. In fact, individuals of this Web

L.N. Janamejoy (✉) · S. Ortiz
Universidad Nacional de Colombia, Palmira, Colombia
e-mail: lnjanamejoym@unal.edu.co

S. Ortiz
e-mail: sortizg@unal.edu.co

S. Ortiz
Colciencias, Bogotá, Colombia

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generation can no longer live outside this "*cybertechnological*" context [2]. Subsequent generations will experience greater technological development, and the teacher must be able to cope and adapt, even on a daily basis. I feel this is possible through education because it is one of the main ways learning is acquired. The preschool period is critical in life. It must have a scientific and systematic organization to shape all areas of development through the experiences it provides. In this sense, preschool education service is the crux of the entire educational system [3].

In the Colombian context, preschool is offered to children less than six years of age, and it provides opportunities for their development in the biological, cognitive, socio-emotional and spiritual areas through socialization experiences and recreation [4].

A glimpse into the future of education warns that technology will be so immersed into the learning process that it will neglect the importance of traditional arts education. It is very possible that this heavy use of technology will place an overly strong focus on preparing individuals for production. The stimulation of human consciousness and the things that surround it, could be set aside by this and cause a repression of creativity, sensitivity, and useful skills. Therefore, the methods and dynamics of teaching must be realigned and reconsidered to incorporate arts with technology, which will allow individuals to grow with essential learning. However, for technological developments and their use in teaching, the learning process should take contextual aspects into account and its impact on the individuals involved [5].

2 Hypothesis

Optimal use of technological tools in the preschool period enables proper introduction of Education 3.0 through new dynamics in the teaching/learning process.

3 Objectives

3.1 General Objective

Determine the impacts of technological tool's use in the teaching—learning process of arts in preschool children of Mi Dulce Hogar kindergarden in Palmira, endorsing or not this new dynamics in education.

3.2 Specific Objectives

- Identify determinants aspects of conventional classes that allows to understand the history, the present and later.
- Compare criteria of conventional classes with the results obtained by the tests, to analyze the attitudes of both teachers and students against the new activity, distinguishing between favorable and unfavorable aspects of both models.

4 Conceptual Framework

The Internet has changed the usual methods by which students learn, and it is especially true for those who have grown up in a digital environment. Some people call this generation "digital-native students," because of the enormous amount of information and knowledge that can be acquired through the Internet from various sources around the world. Education 3.0 will take advantage of this environment. It is characterized by the removal and obsolescence of physical and perceived barriers to the learning environment. Social networks play a very important role in this because they allow students to create collaboratively and to share through learning tools. It requires the student to make new choices with the abundance of information available to them. Therefore, the student is seen as a producer and collaborator in the generation of content [6, 7].

It is pertinent to emphasize that the term "*3.0*" is derived from *Web 3.0* (or the *semantic Web*), which gives meaning to words, and uses that meaning in Web searches to optimize navigation and deliver better results for the user. This is also related to the use of virtual worlds in immersive 3D where users, using avatars, can connect, communicate and interact with each other in real time. Users learn and share this way in the more interactive first person, not third [8]. Some authors [9–11] also refer to the *eXtended Web* (or *Web X.0*), which seems to be connected directly with the collective intelligence and wisdom of the crowds. The Web allows anyone to learn anytime, anywhere, in a personalized way.

Currently, besides the fascinating virtual classrooms, there are many technological tools to complement learning to design and develop quality jobs. Many of these tools are working online, others require downloading, most allow you to share information and work collaboratively, and others allow you to embed in educational spaces. Many of these tools can be run inside or outside a virtual learning environment. They can join to the classroom design to improve it and make it more attractive to users and can be used as a strategy of evaluation of course content, achieving educational/technological innovation [12].

5 Methodology

5.1 Phase 1: Location (Observation of a Conventional Class)

In this phase, relevant data that will be involved in the next phase (test) as the sample was defined. It is necessary to understand their history and possible subsequent learning, the physical space and its conditions, the teachers that would participate in the test, the levels of knowledge acquired by children (because every educational level define which applications would be used in the test), as well as likes and preferences of children to any field of art. This will serve as a reference point to demonstrate the differences when both phases are compared.

Observation of the conventional class was conducted in the kindergarten of "*My Sweet Home*", in the city of Palmira, Valle del Cauca, Colombia. The dynamics and behaviors of both teachers and students were observed in normal classrooms. This activity was carried out for 3 grades, Pre-Garden, Garden and Transition, which are divided by age, 3, 4 and 5 years old, respectively. It was conducted over the course of 2 days in a common classroom and a specialized systems classroom, lasting approximately 20 min per class.

Instruments.

Type of Observation. *Direct observation in the classroom* was carried out in-class by the researcher, which involved several instruments such as the use of audio-visual media, registration cards, record templates, etc. In this case, no audio-visual media was used because of a possible behavior alteration by the behavior of the observer, but a textual record was made on cards according to the objectives of the study [13].

5.2 Phase 2: Testing

Digital Tablets Testing. Digital tablets were installed with an application to draw/paint (iOS *Draw* and Android *Doodle Master* were used) and given to the selected sample: children 4–5 years of age who are in kindergarten, and chosen according to the analysis observation result (Phase 1). In this test, the attitudes of the teachers are evaluated at the time of development of the class (who had previously been instructed in the operation of applications), as the student in the child interaction/tablet environment, and the results of the activity.

Instruments.

- Register: 2 cameras in mode: video, voice recorder and tabs.
- Activity: 8 digital tablets (Android and iOS) with an installed application.
- Measurement: Registration form of observation and Likert scale tab.

5.3 Phase 3: Evaluation

The results were evaluated using SPSS statistical software version 21, where data from previous phases were processed to determine the differences between conventional classes and testing is done. Phase 1 variables were used as the sample and type of application environment were also determined. Later all results were plotted then analysis of the results was made (Fig. 1).

5.4 Observational Analysis and Likert-Scale Questionnaire

The information obtained from the observation of the activity in Phases 1 and 2, was recorded according to the objectives of the study, which is based on a developed method with categories set out in a system analysis of interaction and that encompassing stimulation/professor reaction and response/complement of the student.

In the Likert-scale questionnaire, only attitudes of the students were evaluated. The attitude is a psychological concept that includes cognitive (what is known), affective (what is felt) and behavioral (actions related to an object or idea) aspects [5]. To assess the attitudes of preschool children in relation to what they learn in school, the 3 aspects can be inferred through measurement thereof [13] (Fig. 2).

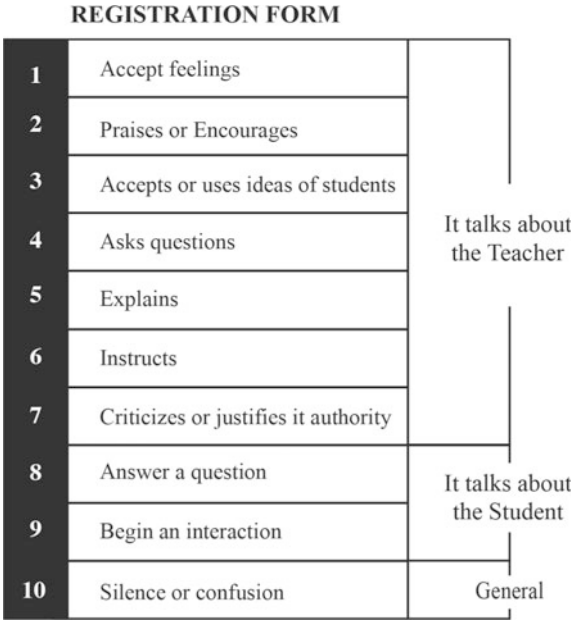


Fig. 1 Registration form used in Phases 1 and 2 for its comparison

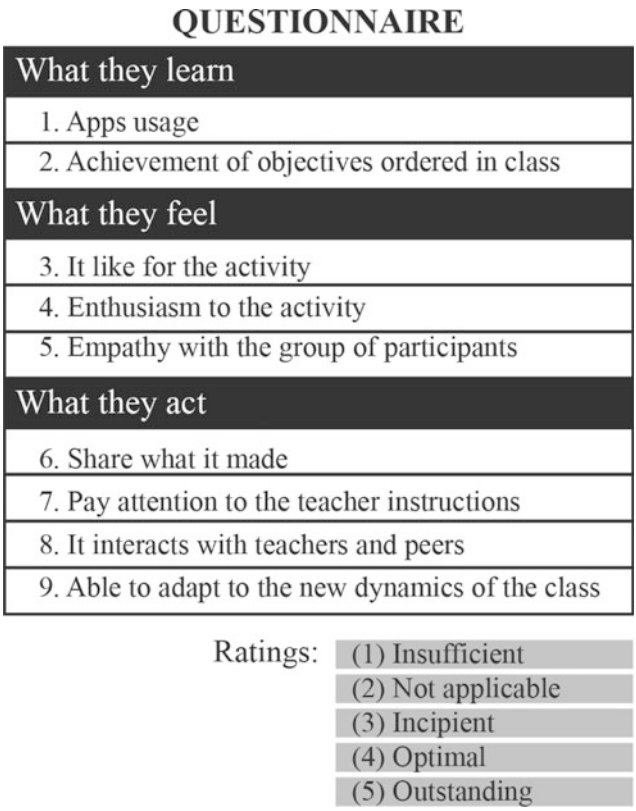


Fig. 2 Likert-scale questionnaire, used in Phase 2 (test), to assess the attitudes of the participants in the activity

6 Results

6.1 Results of Phase 1: Location

After analysis and consideration of application type, it was determined that selection of the Phase 2 sample would come from the kindergarten environment.

- *Sample*: Eight children, 4–5 years of age, male (3) and female (5); and one teacher.
- *Environment*: Two kindergarten classrooms were observed, one for regular classes of varied activities, and the other was a specialized systems classroom, where they used two software programs, (Microsoft Paint and Microsoft Word)

for drawing, coloring and writing activities. The specialized systems classroom presented the best contextual conditions for conducting Phase 2 testing, since that was its purpose.

- *Software o Application Type*: The applications used in Phase 2 testing were chosen after an analysis of the programs used by the children and an informal assessment of their ability to use them. *Doodle Master* for Android tablets and *Draw* for iOS tablets were the applications of choice.

6.2 Results of Phases 1 and 2: Comparisons

The information obtained from the testing of children was processed in the statistical software SPSS, version 21. After comparison, significant differences were shown between the conventional class and activity test, both for teachers and students, and the results are presented in this order. The measurement is given by frequency, or number of times, the teacher said each performance throughout Phases 1 and 2 (duration of 20 min each Phase). These are the graphs of data processing:

Comparison of Results of Teaching in Phases 1 and 2.

See Figs. 3, 4 and 5.

Comparison of Results of Students and in General in Phases 1 and 2.

See Fig. 6.

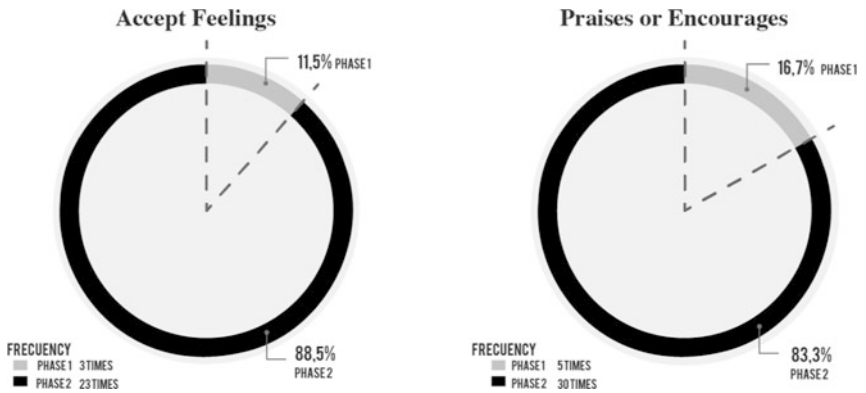


Fig. 3 Variable graphics 1 and 2

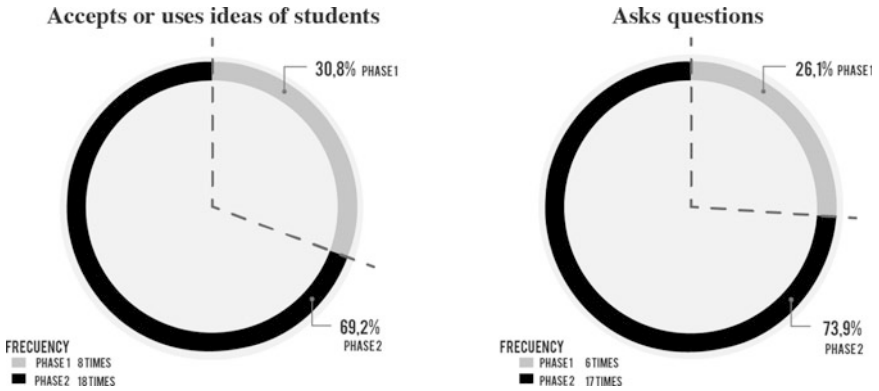


Fig. 4 Variable graphics 3 and 4

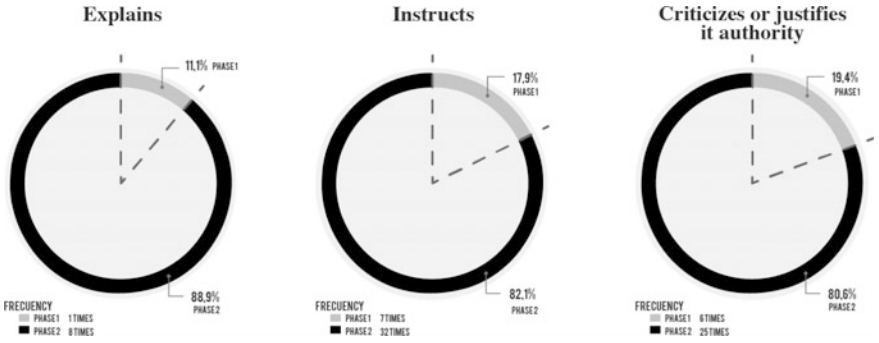


Fig. 5 Variable graphics 5, 6 and 7

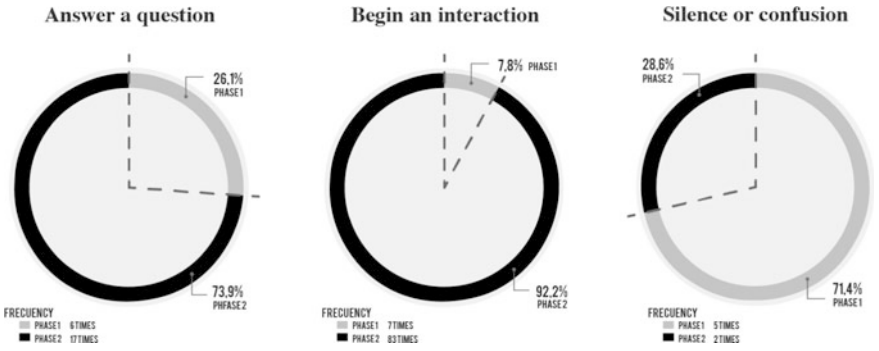


Fig. 6 Variable graphics 8, 9 and 10

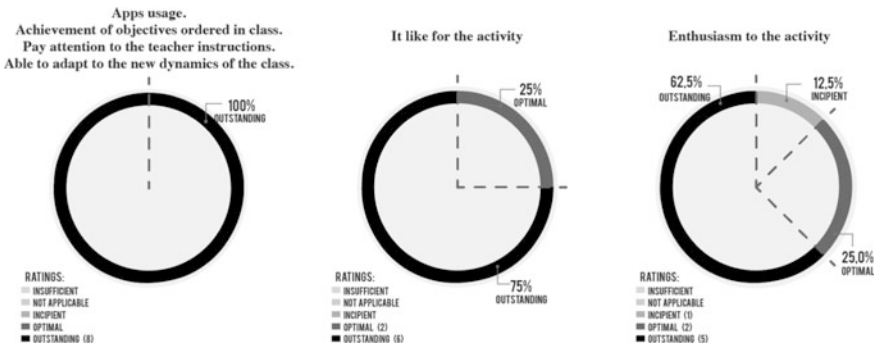


Fig. 7 Variable graphics 1, 2, 7 and 9; 3; and 4 respectively

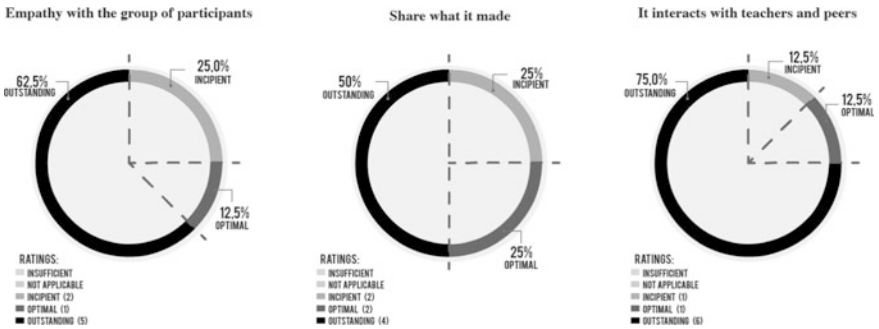


Fig. 8 Variable graphics 5, 6 and 8

6.3 Results of Phase 2: Attitudes

The information obtained from the Likert-scale questionnaire was processed in SPSS statistical software, version 21, where the attitude of the students was measured against the activity of Phase 2. Three aspects were assessed: cognitive, affective and behavioral. The graphical results are shown in Figs. 7 and 8.

7 Analysis of Results

7.1 Phase 1: Location

We were able to establish three key elements to carry out the next phase, these are: definition of the sample, selection of the environment, and the type of application.

7.2 Phase 1 and 2: Comparisons

Data processing of these Phases allowed comparison of the evaluation results of both teachers and students, and in a general aspect. Following this order: (1) the teacher who took part in both phases resented significant changes because in 5 variables there are superiors percentage to 80 % corresponding to Phase 2, highlighting that in the test increased the emotional receptivity to his students; (2) he encouraged the praise in the process of the activity, explained to each of them what the activity was and gave instruction every time a student demanded it, he was also attentive to the process of each student; (3) his authority was strengthened by being more integrated into the activity and not act only as a custodian of the class that was the position he held in Phase 1. The variable 3 with 69.2 % in Phase 2, versus 30.8 % in Phase 1, was evidence of a considerable increase in their conception of ideas of the students using them to gain good results in activity; while in variable 4 73.9 % of Phase 2 versus 26.1 % of Phase 1, was evidence a high increase in use of the question teacher to student, which they managed to interact more and at the same time worked as a tool to apply the results to the students.

The variables assessed 8 and 9 students who also obtained high percentages in Phase 2. Variable 8 corresponds to questions answered by students; it is evident that the percentage value is consistent with variable 4 where the teacher asks questions to students, i.e., students always answered. The variable 9 shows a high percentage differentiator 92.2 % against 7.8 % indicating an increase in student-initiated interactions with their teachers and peers.

Variable 10 measures a general aspect, embracing both students and teacher, Phase 1 with a 71.4 % versus 28.6 % of Phase 2, which means that there was more silence or confusion of the participants during conventional class. From the observation it can be concluded that this behavior is because the software that is commonly used is not appropriate, because the students before doubting, preferred not to ask or do mechanical exercises without any purpose; and meanwhile, the teacher in Phase 1 remained mostly quiet allowing this atmosphere to remain.

7.3 Phase 2: Attitudes

With the Likert-scale questionnaire, 9 variables measured and evaluated 3 attitudinal aspects of the students: cognitive, affective and behavioral. There were four variables (1, 2, 7 and 9) that had a 100 % meaning that all the variables 1 and 2 had the aspects: cognitive was achieved, in terms that the 8 students made outstanding use of the application, evidenced by the achieved objectives and delivered results. The variables 7 and 9 also reached 100 % corresponding to the aspect: behavioral, which comprise two more variables, meaning that half the aspect was achieved in terms of students always abiding by the instructions given by the teacher and that they adapted perfectly to the activity. Concerning the other 2 variables, variable 6 has 50 % of outstanding rating, 25 % excellent and 25 % incipient, meaning that

half of the students (4) shared autonomously what has been done, while the others did not fully show this behavior. Meanwhile, variable 8 speaks of student interaction with peers and teachers, presenting outstanding values of 75, 12.5 % optimal and 12.5 % incipient, i.e. 6 students presented this behavior outstandingly, unlike others (2). As for variables 3, 4 and 5 the following aspects were evaluated: affective, where variable 3 showed 75 % excellent and 25 % optimal, meaning that there was a good degree of acceptance of the activity by demonstrating an enjoyment of it; variable 4 presented outstanding 62.5, 25 % optimal and 12.5 % incipient, i.e. 5 students showed attitudes of full enthusiasm for activity; and in variable 5 it shows that 62.5 % (5 students) had outstanding empathy with other participants of the activity.

8 Conclusions

According to the results and their respective analysis, it is concluded that the introduction of technological tools such as digital tablets and applications in pre-school education can contribute significantly in interactions between the teacher and the student over others, forming a pleasant atmosphere by giving collaboration, dialogue, sharing, etc., whose aspects were identified by a decrease in the conventional class when compared to the test performed, which also played an important and novel role. This factor suggests that the participants have expressed excitement and pleasure to the activity leading to good results. It can be concluded then, that in the hypothetical case of introducing digital tablets to classes, individuals may present the same attitudinal behavior of assimilation of the material work as something exciting at the beginning and then it can become obsolete. However there is an advantage of this technological tool before this possible drawback: interest can be maintained by changes to the interface through constantly updating the software or applications, which enables a large number of topics to be explored, not only the arts, enriching both the dynamics of the classroom and knowledge acquired by students at a fluid pace, maintaining the interest of individuals.

References

1. Escaño, C.: Hacia una Educación Artística 4.0. Revistas Científicas Complutenses **22**. (2010)
2. Méndez, P.: Mundos Cambiantes: La Tecnología y la Educación 3.0. Revistas Científicas Complutenses **23** (2012)
3. Bagci, H., Bayram, A., Özlem, A.: Examining preschool teachers' attitudes about the usage of technological tools in education. Procedia Soc. Behav. Sci. **152**, 143–148 (2014)
4. Ministerio de Educación Nacional República de Colombia. http://mineducacion.gov.co
5. Juárez, M., Delgado, A.: Un Instrumento Para Evaluar Competencias en Niños Preescolares. Consejo Mexicano de Investigación Educativa
6. Keats, D., Schmidt, P.: The genesis and emergence of education 3.0 in higher education and its potencial for Africa. First Monday **12**, 3 (2007)

7. Rahmat, R., Osman, K.: From traditional to self-regulated learners: UKM journey towards education 3.0. Procedia Soc. Behav. Sci. **59**, 2–8 (2012)
8. Hayes, G.: Virtual worlds, web 3.0 and portable profiles. http://www.personalizemedia.com
9. Downes, S.: Web 3.0: the way forward? http://www.downes.ca
10. Kop, R.: The extended web and the personal learning environment. http://www.ritakop.blogspot.com.co
11. Wheeler, S.: Web 3.0: the way forward? http://www.steve-wheeler.blogspot.com.co
12. Duran, N.: Herramientas Tecnológicas Aplicadas a la Educación Preescolar Para Docentes Innovadores a través de un Ambiente Virtual de Aprendizaje Metafórico. http://www.virtualeduca.org
13. Galindo, M.: La Observación en el Aula como Método de Investigación Lingüistica (2006)

Game-Based Learning: Analysis of Students' Motivation, Performance, and Drop Out in a Production Engineering Course

Elissa Danielle Silva, Marcelo Macedo, Clarissa Teixeira, Edgar Lanzer and Álvaro Paz Graziani

Abstract The use of constructivist teaching dynamics gives students the opportunity to experience an environment similar to the reality the classroom. It promotes better assimilation of theoretical concepts to be applied in everyday life of future engineers. This research shows us the contribution of Game-Based Learning (GBL) for the study of the proposed topic and to reduce the evasion of the course. The GBL dynamic was applied to the discipline of Production Systems in the first phase of the course of Production Engineering at a private institution of Santa Catarina, Brazil. We used an analogical game that aimed to simulate production management, and its impacts, in pull and push production systems. A pilot experiment was performed with the game in two classes in one semester, followed by the application of the same game in another two classes the following semester.

Keyword Engineering Teaching · Game-based learning · Production engineering · Motivation · Dropout

E.D. Silva (✉) · M. Macedo · C. Teixeira · E. Lanzer
CTC/UFSC—Rector João David Ferreira Lima Campus, Trindade, Florianópolis, Santa Catarina, Brazil
e-mail: elissadanielles@gmail.com

M. Macedo
e-mail: marcelo5369@gmail.com

C. Teixeira
e-mail: clastefani@gmail.com

E. Lanzer
e-mail: ealanzer@gmail.com

Á.P. Graziani
Unisociesc, Albano Schmidt Street, 3333, Boa Vista, Joinville, Santa Catarina, Brazil
e-mail: algraziani@ibest.com.br

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1 Introduction

The first existing engineering courses in the world, and in Brazil, were mainly aimed at training military officers responsible for national defense, as well as, the development of infrastructure for cities. However, engineering education has been changing from the pedagogical point of view, in order to attract new students and reduce dropout rates. Constructivist teaching methods put the practice of discovery at the heart of teaching with the coverage of scientific knowledge that enables problem solving. This is further enhanced with new digital technologies, which can convincingly simulate immersion in practical problems of engineering [1–3].

Despite the increasing demand for engineering courses in recent years, the number is still considered insufficient to meet the shortage of professionals in the field, given that about 60 % of freshmen drop out before completing their undergraduate degree. In addition, only 48 % of professionals are actually working in the area, due to low salaries and the lack of practical applications for the courses [4, 5].

Nowadays, many freshmen in higher education courses are members of a technological generation. Because of the interaction with a digital environment, young people have little interest in reading books, limited attention spans, low tolerance repeatability, and also a much more visual learning style. One of the peculiarities of this generation is the rapid responsiveness to context changes, making difficult the formal engineering education [1, 6].

Thus, the present study aims to gather elements to organize a proposed use of Game-Based Learning (GBL) in the teaching of Production Engineering (PE) in a private higher education institution (HEI) in Santa Catarina. To this end, we intend to evaluate the application of a game in an introductory course in the program, not only from the viewpoint of increase in student motivation to continue on the course, but also from the perspective of learning effectively achieved and the development of skills required by job market.

2 Drop Out

Drop out can be defined as the voluntary departure of students from attending educational institutions. This is a problem, which causes a misuse of financial, structural, and human resources, since the institution provides them, and the abandonment of students prevents the institution from having any return [7–10].

Throughout the world, there has been a significant increase in the percentage of the population that seeks access to higher education. In Brazil, in the year 2000, 4,039,910 people registered for college entrance. After a decade (by 2011), this number had risen to 9,166,587. From the previously stated figures, 2,51,051 and 1,182,884 people, respectively, enrolled in engineering courses, indicating an increased demand for professionals [9, 11].

By contrast, the increased demand for engineering courses does not necessarily represent an increase in the supply of engineers in the job market, due to the

growing number of people who give up undergraduate studies. Although the methodologies for measuring dropout rates are different, the Organization for Economic Cooperation and Development (OECD) said in a study that only 38 % of students complete the courses [9].

The Graduation Rate for undergraduate Engineering students, in Brazil, corresponds to the percentage of students who began an Engineering undergraduate degree, and completed it, in an ideal time of 5 years. By analyzing this rate from 2004 to 2011, the estimated average of graduate engineers ranged from 40 to 45 % of the total. When taking into consideration the type of institution, this figure is approximately 55 % among public institutions, against nearly 30 % in private institutions, (i.e. 45 and 70 % of the entering students, respectively, did not complete the course.) [11].

Dropping out of college is a phenomenon with many factors. However, studies have shown that the dropout rate in the first year of a program is two times higher than in the rest of the academic life. Furthermore, in Brazil, looking specifically at the field of Engineering, the high dropout rates before the end of the first two years is due to the fact that the students considered the courses too long and very theoretical [8, 9, 12].

A study of dropout students of Automation Engineering from the Federal Center of Technological Education at the Leopoldina campus (CEFET/MG) shows some reasons why students do not complete the program. The most significant reason was dissatisfaction with the course, followed by searching for other training, and lastly, a lack of motivation to continue their education, respectively listed by importance. Other researchers point out financial problems, difficulties in balancing work and dedication required for university study, the cost of education in private institutions, rental or transport, disease, death, transfer of residence, uncertainty about which career path to follow, or failures in the basic cycle of the course can also lead students to give up completing the degree [8, 10, 11, 13].

3 Knowledge, Skills and Competencies of Engineers in Confrontation with the Engineering Education

To [14], the Second World War demonstrated that combining science with technique could generate real and strategically important applications. Examples of this include the computer, the atomic bomb, and jet propulsion. According to him, the engineering courses have become more theoretical than practical at this point in history, incorporating more scientific content into the curriculum.

Engineers are recognized for their scientific training and skills in solving numerical problems. However, considering the constant changes in industrial, economic, political, and social scenarios, engineers have been requested to act in several areas that require logical thinking and analytical skills, often deviating from their original training. The [2] describes that engineers have worked in areas that go beyond their training, such as health, food, aquaculture, genetics, biomedicine, and applied social sciences, in areas such as security, environment and management [1].

[14] agrees by describing that the labor model of the division of functions, requiring only professional specialists on a task, is leading to flexible, multifunctional professionals that have the skills to interact with new technologies. [15] indicates that the fierce competition among manufacturing industries increases the need for the recruitment of qualified engineers and technicians with sufficient knowledge and experience.

The engineering practice has been challenged, and therefore, requires more practical skills than extensive theoretical and scientific knowledge. The twenty-first century engineers need to develop skills, such as creative thinking, good oral and written communication, problem-solving, working in multidisciplinary teams and sustainable development. In addition, initiative, versatility, leadership, decision-making, autonomy, organization, motivation and planning are critical [1, 16, 17].

Duderstadt [1] argues that the interdisciplinary nature of new technologies and the impact of cyberinfrastructure, along with social changes are raising serious questions about the adequacy of the approach to engineering. It is an understandable concern for some teachers regarding the changes in the practice of engineering, given that the training of engineers in the twenty-first century are based on the twentieth century curriculum, adopted by institutions of the nineteenth century.

The education centered on the teacher, through the transmission of knowledge, must give way to the construction of knowledge centered on the student, altering the traditional form of organization in teaching and learning. Some initiatives seek to reconcile the fundamental principles of engineering for educational alternatives to consider the cognitive aspects and encourage the development of the professional skills of the student, in order to adjust the profile of the engineer to the demands of society [18, 19].

One way to develop the required skills and competencies of contemporary world professionals is to get students to experience these skills for the longest period possible. Thus, changing the current teaching methodologies should involve the student in a participatory manner, promoting debates, and exposing them to situations and real problems. The forms of evaluation should also be more comprehensive and diversified to meet the complexity and subjectivity. The intention is to provide a motivational learning style for students who are increasingly exposed to technologies and to make them better professionals and citizens [19–21].

4 Alternative Teaching Methods

Veiga [22] describes that when the teacher asks the students questions, this enables them to participate more with their own ideas, questions, and doubts. They are encouraged to reflect, experiment and innovate without feeling afraid of being criticized or failing.

Leite [19] highlights that the new paradigm involves teachers and students, with the former needing to worry about the learning of the latter. The need is imminent for the adaptation of the planning, organization, and the methods of teaching and evaluation to different learning styles. For this reason, the institutions have sought

educational alternatives that allow the graduate a practical understanding of the various interactions between classroom subjects and reality.

Teachers must adapt to the new reality by seeking a balance between stimulating creativity and leveling opportunities for all students to build their knowledge. Thus, changing the current teaching methodologies should involve the student in a participatory manner, promoting debates and exposing them to real situations and problems, which will create training opportunities for citizens committed to the development of the society in which they live [19, 22, 23].

Within this context, the successful implementation of any teaching method depends on the motivation of the students. Natives of the digital generation learn as much from building as from experiencing, and furthermore are motivated by exposure, competition, participation and collaboration. Thus, effective teaching should consider these four questions [1, 20].

To [21–23], some educational alternatives can be effective in the classroom, provided that they are adapted for the spreading of content in a way that facilitates assimilation by the students, and game-based learning is one of them.

4.1 Game-Based Learning—GBL

The act of playing has several meanings, among them, to play and have fun, provided that it is subject to certain rules. Game-Based Learning (GBL), also called *serious games*, refers mainly to the application of games for educational purposes, through which complex issues are taught in the game. There are several types of activities associated with games, which include simulations, role-plays, puzzles, toys, and stories. There is a difference of opinion among researchers about whether these activities are games or not, but in general, any of these activities can be considered GBL, although some incorporate more game-related elements than others [21].

Among the many definitions found, the best describing GBL was cited by [16], as a system that involves the players in an artificial conflict with established rules, which mainly results in quantifiable academic results. For him, this setting can be used to distinguish educational games from ones used for entertainment and other forms of educational activities.

Whitton [21] lists some motivating elements that exist in games, such as a challenge that requires skills with clear and attainable goals; known rules; complete involvement in the activity; immediate feedback; focus on the tasks; a sense of control; loss of self-consciousness, and processing time. For the author, the more these elements are incorporated in the activity, the more fun, motivating and engaging it is.

Currently, games are known as a promising instructional method in various areas, including Engineering, as they provide students with learning opportunities, placing them in an environment where they can assume different roles in a company [15].

To Bergen [24], playing can be a means of learning for all ages, given that several elements of games can improve the process of learning. The heads of the existing future engineers are recognizing that the creativity and innovative features

in the "games" are often described as important for the professional. In addition, human progress depends on the capacity of playful thought and this promotes efficient adaptation to change. According to her, the game enhances that capacity as it functions as a means of learning and development.

The games have so much potential to create a fun learning environment as they motivate students, because they promote competition as they establish rules, objectives, and results. In addition to providing pleasure to the students, the use of games as a teaching method develops cognitive and affective elements through problem-solving, decision-making, and group findings that help in building their own personality [25].

Deshpande and Huang [6] and Bellotti et al. [26] show that the games, or even the media (animation, graphics, and an interactive environment), are able to challenge and engage players in a real and compelling framework. In this case, they motivate students and show the importance and practical implementation of topics and skills that can be difficult to explain. In addition, the games stimulate critical thinking of players who participate actively, thereby developing the ability to test alternatives and be responsible for the consequences. In addition to [16], as well as feedback that help in learning, the fact of seeking alternatives to problem-solving develops creativity.

Althoff et al. [27] describe the use of teaching techniques, based on games and simulations combined with discussions among participants about the results, which provides an opportunity to aggregate knowledge for academics. This measurement that they are encouraged to analyze if the real situation is possible, promotes an increased ability to solve problems that only experience can provide and enables the comparison of theory with the results achieved in practice.

Deshpande [6] list the advantages of the use of games and simulation: experiential learning and fun; the link between theory and practical application; active participation, which reduces the resistance to accept innovative ideas and concepts; provides immediate feedback in the learning process; gives an opportunity for the students to face the consequences for the results of decisions made; allows a greater retention of students in the course over time compared to the traditional method among others.

However, [21] points out that such advantages are visible when students experience something different from what they were accustomed to. Therefore, despite the educational power of games for learning, drawbacks such as expense, the time required for the preparation of dynamic exercises that integrate the proposed content, and even its subsequent evaluation should be considered. Given the concepts of GBL, the next chapter presents some game experiments in the teaching of Engineering.

4.2 Experiments Conducted in Teaching Engineering

The motivational power of GBL cannot be the only explanation for putting it into practice in the classroom. The topic being studied and the specific group of students

concerned must also be taken into consideration. However, the application of GBL is becoming popular because of the evidence of its benefits in areas such as health, military, and social, among others. In engineering and manufacturing, the games focus on supply chain management issues, new product development, logistics, maintenance, lean manufacturing, sustainable production, capacity planning, in addition to complicated electrical, mechanical, industrial, and aerospace content [15].

Deshpande and Huang [6] conducted a review of existing simulation games used in the teaching of Engineering over the years. For them, this new methodology transforms both the role of the teacher, who becomes a promoter of knowledge, and the student, who assimilates the concepts more actively. Thus, the teaching of Engineering attracts more attention from students and allows implied knowledge to be acquired explicitly.

Graziani [28] proposed the use of LEGO® blocks in a mini-assembly of vehicles by students of PE. In this, the sequencing of production, line balancing, and pull versus push production systems were simulated. To measure the acquired knowledge, he utilized tests before and after the interaction, that made it possible to observe an average increase of progress for the students greater than 50 %.

A combination of Project-Based Learning (PBL) and GBL was performed by [16] using first-year students of Engineering. The intention was to investigate both motivation and engagement as the improvement of knowledge on sustainable development and to develop professional skills upon completion of the experiment. The author believes that a teaching approach combining PBL and GBL consisted of an effective tool for teaching engineering content, not only improving the students' knowledge, but also developing them professionally and motivating them for learning.

The dynamic group exercise involving the pens, [27], points out that the use of GBL in the teaching of PE intellectually develops participants, when considering that it assists in better understanding the theory through practice of the content. The dynamics of games bring into the classroom a sense of learning in a real environment, facilitating the assimilation of concepts to be applied in the professional lives of academics.

The experience of [29], involved PE students amplifying their knowledge in Production Management. Through simple PVC connections, the authors developed the dynamic exercise referred to as Tuberobo, which led students to simulate a production process through a fictitious product. Consequently, the authors found that it was possible to reduce the gap between classroom theory and practice. Experiential learning is also able to increase students' motivation, since it stimulates more participation in the class.

Satolo [30] agrees when he says that the application of a competitive and cooperative teaching style that complements the learning process promotes greater involvement of students. The simulation he conducted dealt with concepts of lean production in the course of PE at the Polytechnic School of Campinas and the University of Jaguariúna. The results are as follows: a practical demonstration of possible difficulties that recent graduates may confront; changing the routine of classes; and also suggestions from the students for modifications and/or adaptations of the simulated dynamic exercises for use in other areas of expertise of the engineer.

To Chang et al. [31], the development of a flexible gaming environment to be applied throughout various disciplines involving decision-making systems, tends to facilitate the comprehension of the concepts of production management, inventory control and cooperation between the various agents in a supply chain. The SIMPLE, was applied to students of Production and Operations Management, as well as those of Supply Chain Management, resulting in the arousal of great interest and motivation among participating students.

5 Methodology

For the consummation of this work, first, analysis was carried out on a Production Engineering course to consider a discipline for which a game would be developed and implemented. From there, a game was elaborated for the Production Systems discipline that was based on the specific content of this course, dealing with the principles, features, and differences between push and pull models of production. Furthermore, a qualitative questionnaire was devised, which focused on the playful dynamic exercise to assess the students' perception. Following this was the application of the game and questionnaire as a preliminary trial with two groups in the first semester of 2014.

After the application of the preliminary trial, alterations were made to both the assembled products by the students in the simulation, as to the evaluative questionnaire. Furthermore, for the final application, a test was made that contained questions about the concepts covered in the game, which were applied in two stages to the participating students in the second semester of 2014. The first stage preceded the application of the game with the intention of verifying the implied knowledge of the students, in respect to the topic. After the simulation, the test was reapplied with the goal of assessing whether there was an increase of student learning.

But the questionnaire, which was applied from the models proposed by [32] and [16], had the intention of evaluating the degree of motivation after the use of this playful teaching methodology and comparing the subsequent drop out of students in this class with historical averages of the same phase. The questionnaire contained not only socio-economic questions, but also an evaluation of the game utilized and the skills that the students considered using in the simulation.

The data obtained in the application of the game and questionnaire were analyzed with descriptive statistic tools and compared with national and international research of a similar nature. In addition, the data also contributed to considering critical factors of success in the implementation of the GBL methodology.

Dropout rates of the groups that were subjected to the experiment with GBL were compared to previous rates in other classes in the same phase of the course, using descriptive statistic tools.

6 Operation of the Learning Game

The intention of the educational game prepared, was to allow even students who did not have real industry experience, an opportunity to experience a bit of the reality of the profession. It was decided that an educational physics resource, called ATTO, should be used in the preparation of the game. ATTO consists of a set of pieces, fasteners, and plastic tools, which let you create different objects, playful activities, and games. Virtual resources were discarded, such as computer simulations and virtual games, due to the difficulty of comprehension and retention of the concepts addressed. Furthermore, the manipulation of objects, as it occurs with ATTO, allows the all the senses of the students to be explored, which helps memorization and improved comprehension of contents presented.

A game was chosen that would simulate a line of production that would encompass both the activities of the warehouse sector and the control process, combining the methods of analysis and times with shipping logistics. The objective of the game consisted of making a group of 30 bar tables, of which were divided into 10 tables for each model (A. tables with a red top and blue feet; B. tables with a yellow top and green feet; and C. tables with a red top and green feet).

The game was performed in two stages, in accordance with the type of sequencing addressed by the study. In the first stage, the assembly of products was simulated in a push production system. In the second stage, a pull production system was used to assemble the same products and to compare the benefits of this approach to the previous.

Push Production: The game started with the presentation of delivery needs. Therefore, three production orders (PO's) were issued, with each order having ten items of each model, to meet a demand forecast. The production sequence was determined from a draw of PO's in which, first, ten tables of model 2 should be assembled, and then assemble ten tables of model 1, and lastly, ten tables of model 3.

In this stage, there was a supply need between the warehouse and the factory, between the workstations, and also between the factory and shipping. Batches of supplies, including raw material, unfinished product, and finished product, from the established rules, must all be of four pieces.

The operations were individually timed, where the timekeeper noted the time elapsed in the assembly of each table. In the same way, the whole process was also timed from the delivery of production orders to the complete loading of three trucks. Each truck holds 10 bar tables and should be loaded with quality approved products, respecting the clients order. This loading order is numbered on the truck itself, and this will be checked to verify if it is accordance with the stipulations.

Following the example above, the shipper should have awaited assembly of the first table of model 3 before initiating the loading of the truck, however, as the tables of model 2 and 1, respectively, were already assembled, these were to remain stored until the beginning of loading.

Pull Production: In this stage, the supply between workstations, and also between the factory and the shipment, was carried out by the Kanban system

without the use of cards, such that the missing piece in the supermarket itself serves as a signal to the previous process to replace what was withdrawn from the following process. The operators produce in a uniform sequence so that the items of the intermediary supermarkets are being consumed by the subsequent process.

In the Pull Production system, it should be leveled and the line needs to be balanced. Considering that the time available for the application of the dynamic group exercise was limited, the leveling and balancing were prepared beforehand, that is, during the preparation of the game. However, it is considered that these steps could be developed by the students, with the times being measured in the previous stage, in order to stimulate the knowledge and understanding of the concepts involved.

It was not considered necessary to time each operation individually at this stage. As the items were not produced for stock and the line was balanced, the shipping operator measures only the total process time.

As in the previous stage, each truck holds ten bar tables and should be carrying the finished products in order to deliver them to the client, corresponding to the confirmed demand. The shipping order is numbered in the truck itself and this was checked to verify if it was according to the stipulations, that is, in the direction of the arrows.

At the end of the simulation, the differences between the push and the pull approach were discussed. Noted was the impact caused from the modifications between the stages in the execution time, layout, supply system, balancing of operations, and in the form of inspection. The theoretical explanation of the improvements made stressed the advantages of the lean manufacturing model over the conventional approach.

7 Results and Discussion

The research results demonstrate that the vast majority of students (78 % from the morning and 100 % from the night) considered the methodology an attractive learning tool, and further, that it could be adapted and utilized in other disciplines to clarify the theory in practice.

The acquired or improved knowledge of the academics after the game were evaluated, and it was perceived that the positive results were similar to those found by [16, 27, 28]. The comprehensive tests from the simulation show that the students from both shifts obtained an increase in knowledge about Production Systems (88 % in the morning and 44 % in the night).

Regarding the skills developed/utilized during the dynamic group exercise, the students from the morning recorded the highest percentage of teamwork, logical reasoning, critical and analytical problem-solving, responsibility, communication, and the management of people, conflict, and motivation. Similarly, the majority of the night students taken into consideration were able to develop or utilize practically all the skills listed in the form. These results are corroborated from the research by

[6] and [16]. The authors assert that the game environment attracts the attention of the students and makes implied knowledge more explicit and enables skilled workers to meet the demands of the industry.

This research also made it possible to verify some difficulties that could impede successful implementation of constructivist teaching dynamics, as in the case of the game. In the authors view, and in agreement with that described by [20], the most relevant considered were:

- The time allocated for the practice should be well allotted for the possibility of its conclusion without rush or commotion;
- Handing over the responsibility of the room arrangement, preservation of the materials, assembling and dismantling of the products by the students;
- The lack of active participation from some students by a limitation in the number of components from the ATTO kit;
- Having the presence of a teaching aid to help the teacher, and the constant feedback regarding the contents derived from the simulation.

This experience made it possible to assess the perceived motivation of the students to complete the course after the utilization of a playful teaching methodology. In this regard, the majority of the night students (75 %) claimed that the game encouraged them to continue in the Production Engineering course. However, the class of morning students remained undecided as to whether the game encouraged them, or not, in the continuation of the Production Engineering Course.

Subsequently, the preliminary level of dropout students involved in this work was compared with historical averages of the course researched at the same stage. For this analysis, the daily class journals of the lecturing professor of the discipline were used, and they verified the enrollment of students involved in the research in the following semester. The results exhibited a downward trend in dropping out, however, despite the positive impact, the results do not allow relation of this fact only to the application of the game, because concurrently in the period studied, there were numerous implemented alterations in the course curriculum as was an increase in offering student financing (FIES). These alterations in the boundary conditions do not permit us to conclude that the reduction observed in the dropout rate of students, who participated in the GBL experience, are a direct and exclusive consequence from this teaching technique.

8 Conclusion

The teaching of Engineering is changing, from the pedagogical perspective, with the intention of attracting new students and reducing dropout rates. Constructivist teaching methods place the practice of the discovery of scientific knowledge in the center of the teaching-learning process. This enables the development of skills and

competencies in the professional that institutions require in the labour market. This aspect is further enhanced with new digital technologies, which can convincingly simulate practical problems for the immersion of Engineers.

The utilization of GBL, or other constructivist group dynamic exercises, provides the student with the opportunity of experiencing, from inside the classroom, an environment similar to that of the real world. This promotes a better understanding of theoretical concepts, to be applied in the practice of future engineers.

References

1. Duderstadt, J.J.: Engineering for a changing world: a roadmap to the future of engineering practice, research, and education. University of Michigan, Ann Arbor, MI (2008)
2. Anísio Teixeira National Institute For Educational Research: Trajectory and state of the art training in engineering, architecture and agronomy. INEP, Brasília, Brazil (2010)
3. Oliveira, de V.F., Pinto, D.P.: Engineering education as knowledge area. In: 34th Brazilian Engineering Education Congress. Passo Fundo, Brazil. (2006)
4. Folha De S.P.: São Paulo: For the first time, engineering has more freshmen than law course. http://www1.folha.uol.com.br/educacao/1262233-pela-primeira-vez-engenharia-tem-mais-calouros-do-que-direito.shtml (2013)
5. Povo Do G.: High dropout rate at the university causes deficit of engineers. Rafael Waltrick. http://www.gazetadopovo.com.br/vidaecidadania/conteudo.phtml?id=1405796&tit=Alta-taxa-de-desistencia-na-universidade-causa-deficit-de-engenheiros (2013)
6. Deshpande, A.A.: Huang, S.H.: Simulation games in engineering education: a state-of-the-art rewiew. Computer applications in engineering education. vol. 19. pp. 399–410. Wiley Periodicals (2011)
7. Molin Filho, R. et al.: Academic dropout data from the EMU production engineering course (from 2000 to 2013). In: 41st Brazilian Engineering Education Congress. Gramado, Brazil (2013)
8. Resende, L.P. et al.: Survey and analysis of dropout data in the CEFET-MG/Leopoldina control and automation engineering course. In: Brazilian Engineering Education Congress. Gramado, Brazil (2013)
9. Rodríguez-Gómez, D. et al.: Understanding Catalan University Dropout From a comparative Approach. vol. 46, pp. 1424–1429. Procedia-Social and Behavioral Sciences (2012)
10. Tomaszewski, L.A. et al.: Production engineering and the labor market: Preliminary reflections. In: 41st Brazilian Engineering Education Congress. Gramado, Brazil (2013)
11. Salerno, M.S. et al. Trends and Prospects of Engineering in Brazil: EngineeringData Report 2012—Training and Labour Market in Engineering in Brazil. São Paulo. Brazil. USP (2012)
12. National Confederation of Industry. Engineering for development—innovation, sustainability and social responsibility as new paradigms. Brasília, Brazil (2010)
13. Aguiar, de G.F., Aguiar, de B.C. X. C., Pilla Jr. V.: Dropout in engineering course: this is only a calculation problem? In: 41st Brazilian Engineering Education Congress. Gramado, Brazil (2013)
14. Vallim, M.B.R.: A reflective model for training engineers. Thesis—Electrical Engineering Course, UFSC, Florianópolis, Brazil. (2008)
15. Pourabdollahian, B., Taisch, M., Kerga, E.: Serious Games in Manufacturing Education: Evaluation of Learners' Engagement. vol. 15, pp. 256–265. Procedia Computer Science (2012)

16. Fang, J.: The use of a game-based project in engineering education: an examination of the academic learning, engagement and motivation of first-year engineering students. Ph. D, Dissertation. Purdue University. Indiana (2012)
17. Santos, C.G.L., Bortoti, M.L., Pereira, M.A.C.: Project-based learning: case study with freshmen in production engineering. In: 41st Brazilian Engineering Education Congress. Gramado, Brazil (2013)
18. Casale, A.: Problem-based learning—Developing skills for engineering teaching. Thesis. Graduate program in Production Engineering and research area in Economics, Organizations and Knowledge Management. EESC/USP (2013)
19. Leite, C., Zabalza, M.: High Education: Innovation and Quality in Teaching. Centre for Research and Educational Intervention—CIIE/FPCEUP. Porto (2012)
20. Veras, Marcelo et al. (Org.). Innovation and teaching methods for natives of the digital generation. Atlas. São Paulo, Brazil. (2011)
21. Whitton, N.J.: An investigation of collaborative computer game-based learning in Higher Education. 2007. 269 f. Thesis, Napier University, St Andrews (2007)
22. Veiga, Ilma P. A. (org.). Teaching techniques: why not? 3rd edn. Papirus. Campinas, Brazil (1995)
23. Antunes, C.: Teachers and "Professauros": Reflections on class and education practices. 7th edn. Vozes, Petrópolis, RJ, Brazil (2013)
24. Bergen, D.: Play as the learning medium for future scientists, mathematicians, and engineers. vol. 1, n. 4, pp. 413–428, American Journal of Play (2009)
25. Ahmad, I., Jaafar, A.: Computer Games: Implementation into Teaching and Learning., vol. 59, pp. 515—519. Procedia-Social and Behavioral Sciences (2012)
26. Bellotti, F. et al.: Designing a Course for Stimulating Entrepreneurship in Higher Education through Serious Games. vol. 15, pp. 174–186, Procedia Computer Science (2012)
27. Althoff, T., Colzani, T.A. Seibel, S.: The dynamics of the automaker pens—a game-based companies simulation in the teaching of production engineering. In: 29th National Meeting Production Engineering. Salvador, Brazil (2009)
28. Graziani, Á.P.: Vehicle Mini Assembly (VMA): Assembly Simulation of Radio-Controlled Vehicles as an Educational Resource for the Teaching of Production Engineering. 102 p. Masters dissertation—Production Engineering, SOCIESC, Joinville, Brazil (2012)
29. Santos, L.C.; Gohr C.F.: Vieira Junior, Milton. Tuberobo: a alternative dynamic for teaching and learning production management. Industrial Management Magazine, vol. 9, n. 01, pp. 122–146. Ponta Grossa, Brazil (2013)
30. Satolo. E.G.: Applied Simulation Model the concept of lean production in Production Engineering Education. Industrial Management Magazine, vol. 7, n. 2, pp. 201–216. Ponta Grossa, Brazil (2011)
31. Chang, Y.-C. et al.: A flexible web-based simulation game for production and logistics management courses. vol. 17, n. 7, pp. 1241–1253, Simulation Modelling Practice and Theory (2009)
32. de Oliveira, M.T.: Proposal for innovation of teaching learning production management discipline. 208 f. Masters dissertation–Management Course, UFSC, Florianópolis, Brazil (2013)

Education for Sustainable Development

Anastasia Nasibulina

Abstract The topicality of a socio-philosophical study of education as an implementation factor of the sustainable development of the society is preconditioned by the fact that the reflected and substantiated understanding of both the axiology of contemporary education, its ability to exert influence on the spiritual and moral priorities of personality, and actualization of the sustainable societal development in the 21st century depend on the educational system. The article views the contemporary state of education for sustainable development (ESD). In author's opinion the ESD is one of the most efficient methods of implementation of sustainable development principles by forming new thinking and behavior. A positive role of environmental ethics in the creation and development of ESD is shown.

Keywords Sustainable development · Education for sustainable development · Environmental ethics · Baikal region

1 Introduction

Nowadays, it is practically a commonly accepted truth that the leading role in the achievement of sustainable development is to be played by education. In many UN documents education is directly referred to as a "decisive factor of change." A broad acknowledgement of education and closely associated upbringing and enlightenment as the decisive factor of transition to sustainable development stipulated the emergence of a phenomenon of education for sustainable development at the turn of the century. A new civilizational phenomenon turned out to be a natural development of the sustainable development concept adopted in 1992 as a global development strategy.

A. Nasibulina (✉)
International UNESCO Chair in Environmental Ethics,
East Siberia State University of Technology and Management,
670013 Ulan-Ude, Russia
e-mail: dn.nastia@gmail.com

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An active work to form an ESD system is underway in the world. In the developed countries it resulted in an impressive development of its institutional foundations and provision of state support. The acceptance of a global ESD project by the humanity is a unique opportunity to upgrade the status of education as a civilizational institution. Besides, it is a real chance to demonstrate the potential of science to the contemporary society and broad introduction into it of environmental culture as a necessary element of the system of knowledge and skills providing real sustainability and well-being of the social medium.

The UN Decade of Education for Sustainable Development provided a powerful impetus to reconsideration of ecological education in the context of sustainable development methodology. It emphasized that everything necessary for the achievement of sustainable development of society is rooted in a system of education where personality foundations are laid: quality of thinking, ability to model and build the future, moral values, ideals and spiritual appetence. Hence, the society needs competent pedagogical cadres with modern comprehensive cultural thinking, formed ecological values and high level of ecological culture.

The main goal of this paper is to study the role of education in the implementation of a global development strategy.

2 Toward a New Concept of Education

Sustainability requires a change in our attitude to production and consumption. In essence, it demands new ways of thinking and behavior in the tideway of global civic consciousness, and new values, skills and knowledge. That is why education for sustainable development should take a central position in a new global agenda in the field of development, currently formed at governmental level.

The notion of "Education for sustainable development" first appeared in the UN documents in the second half of the 20th century. The development of the ESD concept is directly linked to the implementation of the main political documents adopted by the world community at the UN 1992 Conference on Environment and Development in Rio de Janeiro. At this summit it was emphasized that education is one of the key factors of attaining sustainable development. It is then that the world leaders announced that "education is a decisive factor of change" meaning changes to better, sustainable and safe future. The Johannesburg Summit held in September 2002 also proposed to consider education for sustainable development as one of the priorities for the activity of the world community. Highly assessing and supporting this initiative the United Nations Organization declared the UN Decade of Education for Sustainable Development (2005–2014). Based on the results of the Decade of Education for Sustainable Development the UNESCO expert group developed the Global Programme (GAP) to transform the DESD into an institutional process after 2014 [1]. This programme was developed taking into account the DESD experience, previous UN reports on various educational issues, and on the basis of broad consultation with representatives of state and non-governmental

organizations from over 100 countries. After thorough discussions the Global Action Programme was approved at the World Conference on ESD held in November 2014 in Aichi-Nagoya (Japan). In June 2015 the International Conference on ESD was held in Khanty-Mansyisk (Russian Federation). The main goal of the conference was in definition of the ways of implementation of the Global Action Programme on ESD. Characteristically, this Conference used an exclusively broad statement of the "sustainable development" problem. Education was viewed as an active system and universal driver capable of providing a balanced development of various life spheres of the society.

Systems providing quality and innovative education, informing of the population and manpower training contribute to the attainment of a higher life standard and lead to a sustainable future. Education for sustainable development is based on such values as justice, equality, tolerance, sufficiency and responsibility. It promotes gender equality, social cohesion and reduction of poverty and complies with the qualities listed in the Earth Charter Initiative—care about the people around, personal integrity, and honesty. ESD is based on the principles that promote a sustainable lifestyle, democracy and well-being of every single man. Protection and restoration of the environment, conservation of natural resources, their sustainable use, and solution of the problems connected with unsustainable production and consumption, and creation of just and peaceful societies are also among the basic ESD principles.

2.1 Principal Results of Prospects of ESD

Education for sustainable development is a lifetime process going well beyond the limits of formal education and existing in a form of lifelong learning creating conditions for the development of environmental consciousness and formation of ecological culture. One of the key purposes of ESD is the formation of ecological world outlook.

At the moment the main objectives of ESD are the development of systemic worldview and critical thinking, acquisition of new knowledge and skills contributing to sustainable development of the society, teaching healthy lifestyle, nurturing of high moral values, teaching of sustainable consumption and nurturing of social activism.

Among the important achievements of the Decade there are, first of all, the wide recognition of education as the most important and irreplaceable factor of sustainable development in the world, and the development of a strategic approach to the development of ESD on the international and national levels.

The main directions of ESD:

Informing of the society and development of understanding of sustainable development. It becomes clear that a state needs citizens not simply educated and enlightened in the issues of sustainable development, but also understanding their role in its implementation.

Implementation of professional training programs on all levels.
Provision of access to and getting of quality educationThe main goal and priority of all formal educational systems throughout the world is to ensure the accessibility of quality education for all citizens. Besides, this provision is one of the key human rights.
Reiteration of the existing educational programs in the benefit of sustainable development.

The concluding report of the UN Decade of Education for Sustainable Development contains the following most important conclusions made using the data based on the results of ten years of work of the program throughout the world:

1. Educational systems turned their faces to the solution of the sustainable development problems. In many countries nowadays a sustainable tendency of raising the role of education in the solution of social, environmental and economic problems that the world already faces or will encounter in the future may be observed.
2. The process of rapprochement of the agendas in the sphere of development and education is underway. Education, information and outreach activity and training is more and more often used by stakeholders as means of promoting sustainable development.
3. Political leadership proved its necessity by facilitating the formation of organizational conditions necessary to carry our transformations.
4. High efficiency of multistakeholder partnership. Carrying out of the DESD contributed to raising the significance of partnership connections and cooperation between stakeholders. The growing network interactions in the field of ESD between universities in various countries allowed mobilizing the global community and establish mutual assistance for the implementation of ESD.
5. Growing local interest in ESD. Implementation of ESD today includes a number of elements relevant to local context.
6. Application of general institutional approaches in the field of ESD. General institutional approaches are increasingly put into effect and help the students bring their contribution to sustainable development at school or university, in the inner circle and at workplace.
7. ESD contributes to the development of interactive, student-oriented teaching methods. Teaching methods based on active involvement of students, training of critical thinking and problem-oriented education, as the experience shows, are most suited to the development of ESD. Instructors on all levels of education play the key role in this process.
8. Integration of ESD in the system of formal education. At the level of political decision-making there is a growing understanding of the fact that upbringing and education of young children are the foundations of sustainable development. Political attention to the introduction of ESD into the nursery and junior high school curricula is specifically high. The recent decade was notable for the

expansion of efforts in the field of sustainable development at the level of higher education.

9. Entrenchment of ESD principles in the non-formal or informal educational systems. Local communities, families and separate citizens of many countries today more clearly understand at everyday level the problems of environment and sustainable development.
10. Vocational and technical education and professional training assist in promotion of sustainable development. International policy and planning in the field of sustainable development and policy and planning in the sphere of vocational and technical education and training are aimed at the development of "green" economy and environmentalization of skills opening new prospects for the studies and contribute to efforts to boost the potential [2].

Despite successes attained within the frameworks of DESD there are still some serious problems, which only will be solved for the use of the full ESD potential. Among them are: Identification of problems and prospects of implementation of the global program of DESD transformation into the institutional process and a necessity of further institutional entrenchment of ESD; Comprehensive understanding of new pedagogical realities associated with the formation of environmentally oriented worldview and environmental culture at various levels of education, substantiation and statement of relevant pedagogical tasks; Necessity of carrying out of additional studies, conducting monitoring and assessment, development and introduction of efficient methodologies, innovative teaching tools (information technologies, audio-video programmes, textbooks and study guides) for the solution of educational reform issues in the benefit of sustainable development; Necessity of further coordination of efforts in the field of education and in sustainable development sectors.

To provide the strategic direction and deeper involvement of stakeholders in the GAP five priority spheres of activity to promote the ESD agenda were identified.

1. Support at the political level. Large-scale introduction of ESD principles in the educational policy and policy in the field of favorable conditions for the implementation of ESD principles and provision of systemic changes.
2. Reform of the educational sphere and vocational training. Integration of sustainable development principles into the system of education and vocational training.
3. Professional enhancement of educators and trainers. Professional enhancement of educators and trainers for more efficient implementation of ESD.
4. Expansion of rights and possibilities of youth and mobilization of the youth's efforts. Entrenchment of the ESD activity among the youth.
5. Accelerated introduction of sustainable decisions at the local level. Expansion of the scale of implemented programs and network interaction in the sphere of ESD at the local level.

In general, the completed Decade of Education for Sustainable Development may be viewed as a considerable prerequisite of forming culture of sustainable development. Education has to change in such a way that every person will have access to knowledge, skills, and values expanding his rights and capabilities for contributing to sustainable development and carrying out of actions in the name of preservation of nature, greening of the economy and creation of a fair and equitable society.

2.2 The Role of Environmental Ethics in ESD (A Case Study of Baikal Region)

In the course of the UN Decade of Education for Sustainable Development, on the basis of the analysis of national and international educational practices and experience of activities of educational establishments an ESD strategy for the Baikal region was developed. Education should be based on the traditions of classical education, such as fundamental character, depth, interdisciplinarity, continuity and humanism. That said, the systemic approach to the interaction of man, society and nature should be at the heart of this process. Besides its traditional function, i.e. transfer of knowledge, the system of education for sustainable development has to fulfill new functions, those of foreseeing and forecasting of the sustainable future, formation of a noospheric personality type capable of implementing the sustainable development concept. The new noospheric system proposed by V.I. Vernadsky should be based on the ecological imperative in the relationships of man and environment. The society should always be responsible to nature. In the connection with the fact that the notion of responsibility is an ethical category, environmental ethics may act as one of the main instruments in the system of education for sustainable development [3].

Environmental ethics is a teaching about co-evolutionary relationships of human beings with the environment based on the perception of nature as a moral partner as well as equal value and equality of all living beings. According to the environmental-ethical concept of the noosphere the main objective of environmental ethics is to construct a system of value and normative paradigms of the society that determine harmonious relations of man and nature. Attainment of this goal presupposes solution of the main issues of the sustainable development of the humanity (limitation of overconsumption by the rich and eradication of poverty; limitation of material consumption and stimulation of spiritual (scientific, artistic) creative activity as a form of being of man in the world; provision of sustainable use of material and intellectual resources of the society, non-decreasing growth rate of productivity of social and natural systems not only at present, but also in future; preservation of integrity, beauty, diversity and sustainability of all environmental systems of planet Earth). The axiological reorientation of the society is aimed at overcoming the consumerist intentions of the industrial civilization [4].

Education in the Baikal region generally reflects common tendencies of education development in Russia, but displays some peculiarities based on cultural and historical circumstances and conditions of nations settled in this region. The main goal is to integrate the principles of sustainable development and environmental-ethical traditions of the indigenous peoples into the educational system of the Baikal region. The educational paradigm features the following aspects expressing the integrity of the common and the specific:

1. Connection of education with cultural tradition, human striving to be capable of cross-cultural communication and absorbing values of the new globalized civilization;
2. Change of education model: from knowledge about nature to nurturing value-based attitude to it, from national-local to noospheric-global;
3. Orientation toward values of global and regional sustainable development [5].

Ethical and environmental upbringing for the sustainable development of the Baikal Natural Territory is a specific feature of the educational paradigm of the Baikal region. Its main vector is formation of respectful attitude to the world natural heritage site—Lake Baikal and other natural sites based on understanding of the inherent value of nature and its deep understanding from scientific and ethical viewpoints.

Nowadays the main task is to develop the axiological foundation of ESD taking into account the local specificity and cultural peculiarities based on the environmentally-oriented worldview enabling every person to acquire knowledge, skills, values and approaches expanding his rights and possibilities for the contribution to the sustainable development, taking competent decisions and carrying out of responsible actions in the name of integrity of the environment, economic expediency and just society for this and future generations.

3 Conclusion

In the conditions of a global crisis education represents the most efficient way of forming a social and intellectual basis for the implementation of sustainable development principles and coevolution ideas. Due to mounting problems related to sustainable development the need of education for sustainable development continues growing.

Success in the implementation of sustainable development ideas, environmentalization and socialization of all sides of life depends on active position and personal motivation of every individual. This determines the necessity of educational and outreach activities, targeted work of mass media, social advertisement and the sphere of culture. It is the level of culture that determines the environmentalism of behavior, choice in favor of knowledge economy and understanding of the necessity to immediately solve social problems. Principal role in the

provision of ideas about modern development priorities in the system of education and training belongs to civic society and expert community.

ESD is not an additional subject or research field, but a new goal of education. If the system is reoriented, the understanding of how to use the current objectives to introduce sustainable development for working out of new requirements and principles will result. Such objectives include: solution of local and global social, economic and environmental problems in such a way so that it would contribute to the formation of a new type of educated man—a "global citizen"; reorientation of science, technology, engineering and mathematical curricula for the solution of real problems of sustainability.

Taking into account international recommendations on balance and integration in the content of the contemporary education of three fundamental problems of sustainable development: economic, social and environmental, ESD should be based on value-oriented, cross-disciplinary integrated education contributing to the development of a system of thought, understanding of the scientific worldview and formation of new values based on the environmentally oriented world outlook and environmental ethics.

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References

1. Proposal for a Global Action Program on Education for Sustainable Development as follow-up to the United Nations Decade of Education for Sustainable Development (DESD) after 2014
2. Aichi-Nagoya Declaration on Education for Sustainable Development (2014)
3. Vernadsky, V.I.: Nauchnaya misl kak planetarnoe yavlenie [Scientific thought as a planetary phenomenon]. Nauka, Moscow (1991)
4. Saktoev V.E., Mantatov V.V.: Tcivilizatcionnye osnovaniya I perspecyivi ustoichivogo razvitiya Baikalskogo regiona [Civilization Foundations and Perspectives of Sustainable Development of the Baikal Region]. Vestnik VSGUTU № 2, Ulan-Ude, 103–109 (2010)
5. Nasibulina, A.S.: Obrazovanie v interesah uctoychivogo razvitiya: problemy I perspektivy [Education for sustainable development: challenges and prospects], pp. 280–288. Ekologicheskaya etika i tehnologii ustoichvogo razvitiya v XXI veke. Izdatel'stvo VSGUTU, Ulan-Ude (2014)

Get Me to the Dojo: An Experiential Learning Experience

Tina Sayer and James P. Foley

Abstract The Toyota Technical Center wanted to implement a companywide safety campaign to discourage the use of cell phones while walking. However, the traditional posters and directives from management did not seem to be working and a new approach was needed. The goal was to create an obstacle course that would be interesting enough to assess situational awareness and be fun for the participant. Thus the "Walking Dojo" was created to demonstrate that cell phones and walking don't mix. A known measure of workload, the n-back task, was used to provide a consistent surrogate task for texting. The Dojo effectively demonstrates that walking while cognitively loaded significantly increases the time to negotiate the Dojo and increases response time to the n-back task. The lessons of the Dojo can contribute to safe walking whether it is crossing a street or on a factory floor.

Keyword Distracted walking · Cognitive load · n-back task

1 Introduction

Everyone should know that texting and driving don't go together and can endanger both the driver and all those around him or her. What about texting and walking? Surely you can chew gum and walk at the same time, right?

March 10, 2015 Lakeland, FL. A 27-year-old woman walked in front of a train while texting on her cell phone, Lakeland police said. She appeared to be texting Monday afternoon as she walked around the crossing gates and into the path of a passing freight train in Lakeland. Miller was clipped by the train and tossed into the

T. Sayer (✉) · J.P. Foley
Toyota Collaborative Safety Research Center, 1555 Woodridge Ave, Ann Arbor, MI, USA
e-mail: tina.sayer@Toyota.com

J.P. Foley
e-mail: james.foley@Toyota.com

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air. She suffered a compound fracture to her right arm and her right leg was also injured [1].

Fortunately not all incidents of texting and walking are this dramatic. But distracted walking is a growing problem in both the workplace and on streets and roadways.

1.1 Distracted Pedestrians

On average, a pedestrian is killed every 2 h and 8 min in traffic crashes [4]. In 2013, 4,743 pedestrians were killed representing 14 % of all traffic fatalities. An estimated 76,000 pedestrians were injured in traffic crashes in the United States. One fifth of the children from birth to 14 killed in traffic crashes were pedestrians. According to an October 2014 report from Safe Kids Worldwide, teens routinely engage in distracted walking behaviors when crossing the street, with 38 % saying they listen to music on headphones, 12 % reporting they text and 14 % talk on their phones [1]. In 2012 alone, a teen pedestrian was killed or hurt every hour after being hit by a car in the U.S., with 284 killed and another 10,000 injured. And it's just not a teen issue, walkers 65 and older accounted for 20 % of all pedestrian fatalities in 2012, a fatality rate higher than any other age group [4].

1.2 Solution to the Problem: The Walking Dojo

The Toyota Technical Center (TTC) workplace safety campaign, including No Cellphone while walking (CHIPS, Fig. 1), was found not to be effective. Employees were not getting the message that walking while texting on a cell phone was both dangerous and inefficient. A better way was needed to communicate that cell phones and walking don't mix.

In order to make the safety message more memorable, TTC created a fun and informative obstacle course in order to demonstrate the degradation in performance due to combining texting and walking.

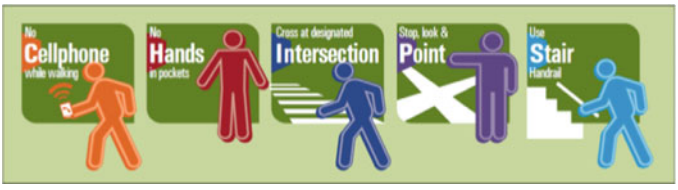


Fig. 1 CHIPS poster

A dojo is a Japanese term which literally means "place of the way." The term typically refers to a formal place to conduct training, so the obstacle course quickly became known as the Walking Dojo.

1.3 The Walking Dojo

The Walking Task. The Dojo is a maze-like course that contains a number of obstacles to avoid while "texting". The Dojo was designed to be professional and portable, so that can be easily deployed (Fig. 2).

The Dojo is constructed of flexible cardboard walls that can be reconfigured to fit the space available. Two large screen televisions are used to display target words that are used to assess situational awareness (Fig. 3). To ensure participant safety, two wireless cameras are mounted in the Dojo to monitor progress, record participant mistakes and most importantly, to be able to provide help should a participant stumble while in the Dojo. Obstacles include a crosswalk with wireless communication to control the WALK/DON'T WALK signal and a photo-realistic open manhole cover (Fig. 3).

Surrogate Texting Task. The surrogate texting task is a delayed digit recall task, or n-back task [3, 5]. The n-back task is a well-established methodology for inducing graded levels of cognitive workload. The n-back requires participants to hold single digit numbers in memory and to respond either immediately (0-back) or after another number has been presented (1-back, Table 1). The MIT AgeLab developed an Android app to present the n-back task. Digits 0–9 are randomly presented, using the tablet's speaker, every 2.25 s. The participant responded by entering a their numeric answer on the tablet. The app also collected response times and number of correct responses.

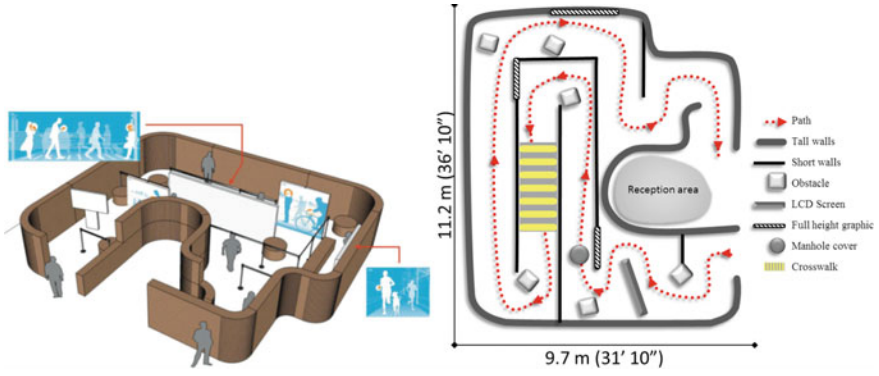


Fig. 2 Concept sketches and layout of the Dojo



Fig. 3 Walking Dojo's pedestrian crossing

Table 1 Example of stimuli and responses for the n-back task

Stimulus:	6	9	1	7	0	8	4
0-back response	6	9	1	7	0	8	4
1-back response	–	6	9	1	7	0	8

The Dojo was used at TTC and team members who completed the Walking Dojo were surprised by the negative impact that "texting" and walking had on both their performance and situational awareness.

2 The Dojo Evaluation

Although the Dojo had had successful demonstrations, where participants provided positive feedback on the issue of distracted walking, a more rigorous evaluation was desired. The evaluation was undertaken at the 2015 Lifesavers Conference, a national conference for safety professionals.

2.1 Method

Participants. Data was collected from 68 conference attendees. Approximately 68 % agreed to fill out questionnaires and of those, 54 % volunteered to be

contacted in about 1 month for a follow up survey. And, finally 38 % of those, filled out the follow up survey. The gender split was roughly 50/50. Twenty percent reported their age as 20–34, 60 % as 35–54 and 20 % as 55–65.

Assessments of Attitude and Behaviors. The Susceptibility to Driver Distraction Questionnaire (SDDQ), which measures a multitude of factors about a person's behaviors, attitudes, and habits concerning distracted driving, was developed by University of Toronto under contract to Toyota's Collaborative Safety Research Center (CSRC) [6]. While the scenario for the SDDQ is driving, the scenario for assessment of distracted walking was 'walking in a large parking lot.' Modifications to the SDDQ made it applicable to the walking scenario and resulted in the Walking SDDQ (WSDDQ). A few of the distracting behaviors (DB) needed to be changed to fit walking (i.e., there were no questions about in-vehicle systems, 'passengers' was replaced with 'other people walking with you', etc.) Table 2 is a list of the subscales used and at which point they were administered. Questionnaires can be found in Tables 3, 4, 5 in the Appendix.

Procedure. The Dojo was set up in the exhibit space at Lifesavers and all conference attendees were invited to experience it. If the participant agreed to participate in the evaluation study, they were provided with informed consent information and assured that their identity would not be disclosed. Participants who did not want to participate in the study were still allowed to experience the Dojo

Table 2 WSDDQ subscales and administration questionnaires

#	WSDDQ subscales		Pre-dojo	Post-dojo	Follow up
Q1	Engagement—walking	Frequency of engaging in DB	Yes	–	Yes
Q2	Attitude-positive	Positive evaluation of outcome, benefits of DB	Yes	Yes	Yes
Q2	Attitude-negative	Negative evaluation of outcome, costs of DB	Yes	Yes	Yes
Q3	Self-efficacy	Perceived ease of performing DB	Yes	Yes	Yes
Q4	Descriptive norms	What other people do	Yes	–	Yes
Q5	Perceived controllability	Degree to which DB is under walkers control	Yes	–	Yes
Q6	Habitual engagement	Degree to which DB is habitual	Yes	–	Yes
Q7	Involuntary Engagement	Control of performing DB is involuntary	Yes	–	Yes
Q8	Engagement–Driving	Frequency of engaging in DB	Yes	–	Yes

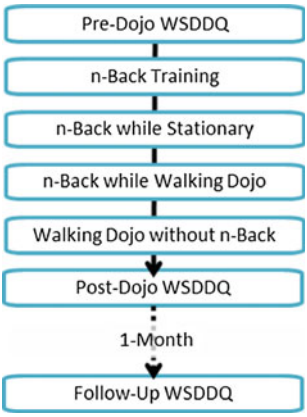


Fig. 4 Task order in evaluation of walking Dojo

and did not fill out any questionnaires. Demographic information was collected and the Pre-dojo portion of the WSDDQ was administered.

Next, the n-back task on the tablet was explained and the participant was allowed to practice. Once the participant was comfortable with the n-back task, they performed a 30-s, stationary 1-back session. Response time and number of correct responses were recorded in the app. The participant then walked through the Dojo while completing the n-back task on the tablet. Again, response time and number correct on the n-back task were recorded. Additionally, time to complete the course and number of errors (i.e., running into a barrier, stepping into the "manhole" or missing the pedestrian signal) were recorded by an experimenter.

Finally the participant walked through the Dojo without performing the n-back task. The time to complete the course and number of errors were recorded by the experimenter. After completing the Dojo, the Post-dojo set of WSDDQ questions were administered, which completed their experience.

If the participant agreed to take part in the follow-up, a link to the follow-up WSDDQ was sent about 1-month after their first exposure to the Dojo. Only participants who provided an email address were contacted. Figure 4 shows the order for the tasks.

3 Results

3.1 Performance Data

The time to respond to the n-back task increased significantly while the participants navigated the Dojo versus standing still ($t_{66} = -4.707, p < 0.001$, Fig. 5). The time to navigate the Dojo also increased significantly while the participant simultaneously performed the n-back versus no cognitive loading task ($t_{66} = 15.167, p < 0.001$, Fig. 6).

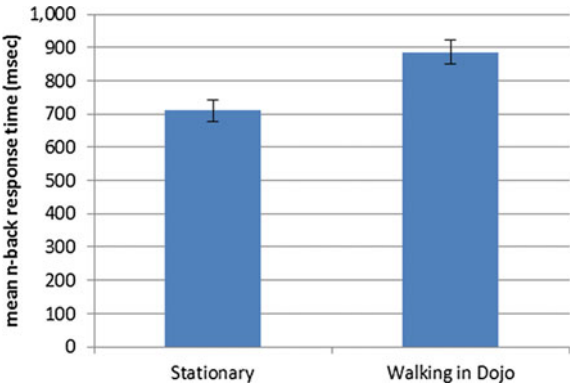


Fig. 5 n-back response time

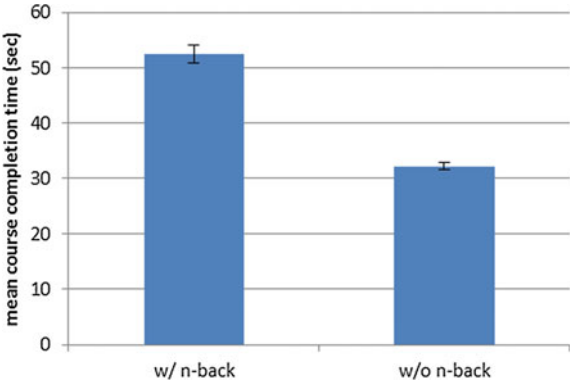


Fig. 6 Course completion time

Neither the n-back response time nor the course completion time had any significant interactions with gender or age.

3.2 Questionnaire Data

Engagement. Questions about task engagement while walking and driving were asked at Pre-dojo and in the 1-month follow-up. A measure of task engagement could not be taken post-dojo, as the time frame of the questions were behaviors in the *last week*. For task engagement while walking, the reported frequency decreased from pre-dojo to follow-up ($F_{1,\ 13} = 7.121, p = 0.019$, Fig. 7). In contrast, the engagement rate while driving did not significantly change ($F_{1,\ 13} = 0.964, p = 0.347$).

Attitudes. Attitudes toward performing DB while walking was assessed by two questions. First, a positive attitude toward DB while walking was assessed with the question "It is a good use of my time to walk and at the same time…." A negative

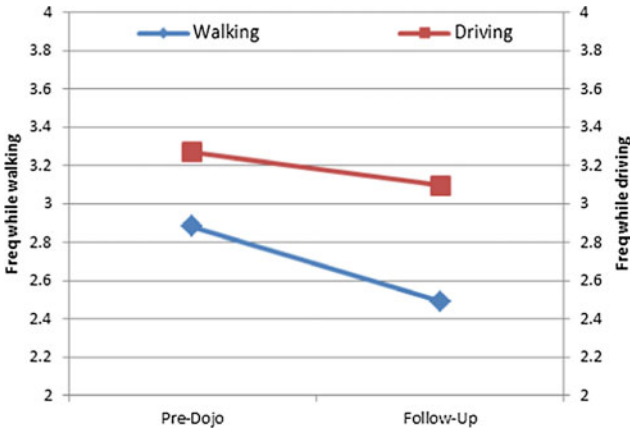


Fig. 7 Distracted behavior engagement while walking or driving

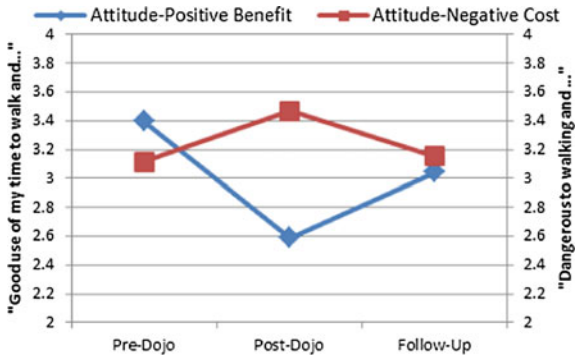


Fig. 8 Average positive outcome/benefit and negative outcome/cost associated with DB

attitude toward DB while walking was assessed with the question "It is dangerous for me to walk and at the same time…." These questions were asked pre-dojo, post-dojo and at follow-up. Only for a positive outcome/benefit was a statistically significant difference found ($F_{2,\ 24} = 6.923$, $p = 0.004$, Fig. 8). The decrease in average score in the post-dojo measurement indicates less of a benefit was perceived than at pre-dojo. Post hoc analysis determined there was a statistical difference was between pre-dojo and post-dojo and pre-dojo to Follow-up. For the negative outcome/cost, no significant difference was found ($F_{2,\ 24} = 1.775$, $p = 0.191$).

Self-Efficacy. One's perceived ease to perform the tasks while walking was assessed with the question "I have no difficulty walking and at the same time…" These questions were asked pre-dojo, post-dojo and at follow-up. A significant difference was found ($F_{2,\ 22} = 6.286$, $p = 0.007$) and post hoc tests revealed the significant

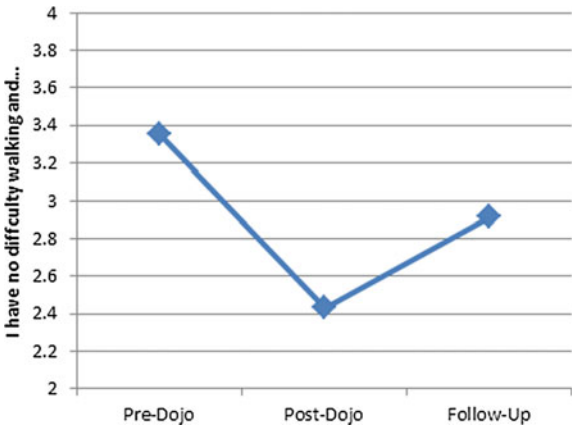


Fig. 9 Average self efficacy ratings

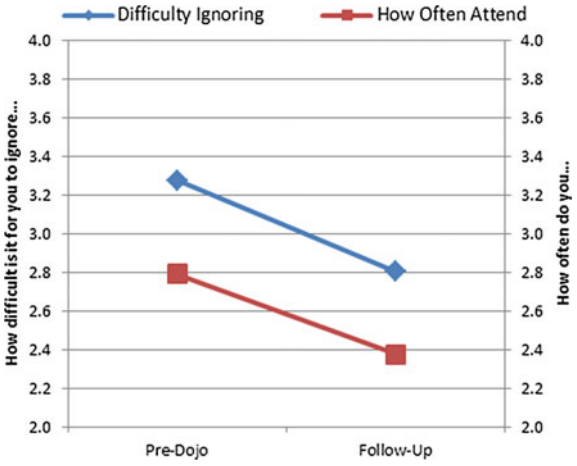


Fig. 10 Averages for involuntary engagement

comparison between pre-dojo and post-dojo only (Fig. 9). The difference in average score from pre-dojo to post-dojo indicates that participants thought walking while performing a DB was more difficult after they had experienced the Dojo.

Involuntary Engagement. Involuntary engagement was measured with two different constructs: difficulty to ignore a cue and frequency of the DB. Difficulty to ignore a cue significantly changed from pre-dojo to follow-up ($F_{1,\ 11} = 8.048$, $p = 0.016$); however, frequency did not change ($F_{1,\ 11} = 2.895$, $p = 0.117$, Fig. 10).

Descriptive Norms, Perceived Controllability, and Habitual Engagement were also examined, but not found to be significant.

4 Discussion

The performance data shows a decrement when the participants were doing two tasks simultaneously (navigating the Dojo and n-back). The n-back response time was longer when the participant was walking through the Dojo than when standing still (single task). The time to complete the Dojo course was significantly longer when the participants were performing the n-back than when they were just walking. This indicates that increasing cognitive load can reduce physical performance.

The frequency of task engagement from pre-dojo to the 1 month follow-up decreased for walking, but not for driving. It was hoped that a transfer of training effect would have been found; training about distracted walking would not only affect walking task engagement, but also driving task engagement. In terms of attitudes, there was a decrease in the positive attitude of engaging in DB while walking after experiencing the Dojo. That difference was most pronounced immediately after exposure to the Dojo. The effect was still found at the 1 month follow-up. When asked about their difficulty when walking and performing DBs, the perceived difficulty increased after experiencing the Dojo. However, the effect was not seen at the 1 month follow-up. When asked about their difficulty to ignore a cue from a mobile device, the average scores show a significantly greater ability to ignore the 'siren call' of the cell phone in the follow-up. The frequency in which they attended to the phone tasks did not change.

4.1 Limitations

There were a small number of participants that responded to the 1-month follow-up survey, limiting the generalizability of those responses. The sample was taken at the Lifesavers conference where the attendees are dedicated to improving all aspects of safety, which could bias the data to show a greater effect than if the sample were more representative. In future, data should be collected at Dojo deployments with a more general audience. Additionally, the order of the tasks was not counterbalanced and the participants served as their own control, so learning effects cannot be discounted.

5 Summary

The response to the Dojo by participants and TTC management was positive. The performance data shows reaction time and total task time were longer when using the texting-like app (i.e., under cognitive load). Changes in frequency of distracting behavior, attitudes and perceptions of performing DB while walking, all show the

Walking Dojo is an effective tool for communicating the issues with distracted walking.

Anecdotally, the experience surprised most participants and shook their confidence in their ability to multi-task successfully. Not only did it take them much longer to find their way through the Dojo while typing into the tablet, but they also made mistakes in responding to the n-back task.

Based on the high level of acceptance at Lifesavers, and within Toyota, the Dojo received the 2015 TTC President's Safety Award Recognition. Additionally, there has been interest in the Dojo. CSRC has received enquiries from both internal and external agencies about either having the TTC Dojo deployed at additional sites or helping agencies to build their own Dojo.

Appendix: Questionnaires

Tables 3, 4, 5

Table 3 WSDDQ questionnaire: questions and instructions

Q#		Question
"Scenario: Please answer the following questions based on your experiences as a pedestrian in a large parking lot (e.g., mall parking lot). Simply check the box that is appropriate for you."		
Q1	Engagement—Walking:	"On average, how often do you engage in each of these tasks in a typical week while walking in a parking lot?"
"For the following statements, please indicate to what extent you agree or disagree with each statement by marking the box that is closest to your opinion."		
Q2	Attitude—positive	"It is good use of my time to walk and at the same time…"
Q3	Attitude—negative	"It is dangerous for me to walk and at the same time…"
Q4	Self-efficacy	"I have no difficulty walking and at the same time…"
Q5	Descriptive norms	"Most people around me walk and…"
Q6a	Perceived controllability	"It is mostly up to me whether I walk and at the same time…"
Q6b		"Checking my phone for new notifications is something…"
Q7a	Involuntary Engagement	"While walking, how difficult is it for you to ignore…"
Q7b		"While you are walking, how often do you…"
"Distracted Driving: Using your experience driving in an urban environment, please answer the following questions as best as you can."		
Q8	Engagement—Driving	"On average, how often did you engage in each of these tasks over the last year while driving in an urban environment?"

Table 4 WSDDQ questionnaire: behaviors

Distracting behaviors	Q1	Q2–6a	Q6b	Q7a	Q7b	Q8
Hold phone conversations	✓	✓				
hold phone conversations on a hand-held device (e.g., phone or tablet)						✓
hold phone conversations on a hands-free device (e.g., phone or tablet)						✓
Text or email on a mobile device (e.g., phone or tablet)	✓	✓				✓
Interact with an app (e.g., navigation, games, banking) on a mobile device	✓	✓				✓
adjust the settings of in-vehicle technology (e.g., radio or AC) using controls on the console						✓
Listen to music, radio, or an audio book using headphones	✓	✓				
listen to the radio or an audio book						✓
Chat with other people walking with you, if there are any	✓	✓				
chat with passengers if there are any						✓
Eat or drink	✓	✓				✓
Get lost in thought, i.e., daydream	✓					
I do without thinking			✓			
I start doing before I realize I am doing it			✓			
I do without meaning to do it			✓			
that would require effort not to do			✓			
that is typically 'me'			✓			
that belongs to my daily routine			✓			
the ringing of your cell phone (e.g., incoming call), when you do not intend to answer				✓		
an alert from your cell phone (e.g., new message, incoming call)				✓		
an alert from your cell phone about an update on social media				✓		
Find yourself having looked away from your path for longer than you intended to?					✓	
Find yourself walking into people or objects?					✓	

Table 5 WSDDQ Questionnaire: scales

Scales	Q1, 8	Q2–4	Q5	Q6a	Q6b	Q7a	Q7b
0 = I don't use this technology, 1 = Never, 2 = Rarely, 3 = Occasionally, 4 = Often, 5 = Very Often	✓						✓[a]
0 = I don't use this technology, 1 = Strongly Disagree, 2 = Disagree, 3 = Undecided, 4 = Agree, 5 = Strongly Agree		✓	✓[a, b]	✓[a,b]	✓[a]		
1 = Very Easy, 2 = Easy, 3 = Neutral, 4 = Difficult, 5 = Very Difficult						✓	

[a]No "0" answer available
[b]"3" was changed to "neither agree or disagree"

References

1. Cops: Texting Woman Walked into Path of Train. Orlando Sentinel, 10 Mar 2015. Web 16 Oct 2015
2. Ferguson, R.W., Green, A., Rosenthal, K.: Teens on the Move. Safe Kids Worldwide, Washington, DC (2014)
3. Reimer, B., Mehler, B., Arrendondo, S., Gulash, C., Foley, J., Waldmann, A. The MIT AgeLab n-back: a multi-modal android application implementation. AutomotiveUI '14, Seattle, WA, USA http://dl.acm.org/citation.cfm?doid=2667239.2667293
4. Traffic Safety Facts, DOT HS 812 124, Washington DC, February 2015
5. Mehler, B., Reimer, B., Coughlin, J. F. (2012). Sensitivity of physiological measures for detecting systematic variations in cognitive demand from a working memory task: an on-road study across three age groups. Hum. Factors **54**(3)
6. Feng, J., Marulanda, S., Donmez, B.: Susceptibility to driver distraction questionnaire. Transp. Res. Rec.: J. Transp. Res. Board **2434**, 26–34 (2014)

The Influence of Team Members' Thinking Style on the Collaborative Design Process

Guan-Ting Liu and Wenzhi Chen

Abstract Team member composition is an important factor in collaborative design. The purpose of this study was to explore the behavioral differences in the collaborative design process with different team members' thinking style composition. A design process of nine design teams with three different thinking style composition types was selected from a previous study. The material was transcribed and coded according to behavior, discussion, drawing, and writing. The numbers of concepts, sketches, and consensus were also calculated. The results illustrated different behaviors with different thinking style compositions.

Keywords Thinking style · Collaborative design · Behavior

1 Introduction

With the rise of globalized business, the importance of design has increased. In addition, products have become more complex, and collaborative design has become the mainstream of product design and design development to increase creativity and competitiveness.

The performance of the collaborative design team is affected by many factors. Members' composition is one of the most important issues for discussion [1]. A previous study [2] conducted experimental collaborative design projects to discuss the outcome of the different thinking style composition of team members. The purpose of this study is to explore the influences of team members' thinking

G.-T. Liu · W. Chen (✉)
Department of Industrial Design, College of Management,
Chang Gung University, 33302 Guishan, Taoyuan, Taiwan, ROC
e-mail: wenzhi@mail.cgu.edu.tw

G.-T. Liu
e-mail: guanting219@gmail.com

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style composition on the collaborative design process. A video of experimental collaborative design projects by Laio [2] was analyzed to explore the behavior through the design process.

2 Literature Review

2.1 Design Thinking and Protocol Analysis

A design thinking study integrates design studies and cognitive science. It focuses on the change in thinking through the design process [3, 4] to understand designers' thinking and problem-solving process.

The protocol analysis is one of the most used methods of design thinking studies for understanding the design thinking process of designers and their activities. It is based on information processing theory of psychology [5, 6]. The main argument is that thinking is the outcome of the human information process. Protocol analysis can be carried out through the coding, and decoding can reveal thinking behavior. However, this takes time, so it's difficult to analyze numerous subjects [7].

2.2 Thinking Style and Collaborative Design

Design is regarded as an intuitive activity and described as a black box [8]. Sternberg [9] proposed the theory of thinking style to illuminate the way people think. His study described 13 separate styles and five dimensions that comprise his theory of thinking styles, including functions, forms, levels, scopes, and leanings. Table 1 shows the dimensions, styles, and the essential characteristic of each style.

Table 1 Dimensions, styles, and the essential characteristic of thinking styles

Dimensions	Styles	Key characteristic
Functions	Legislative	Being creative
	Executive	Being conforming
	Judicial	Being analytical
Forms	Monarchic	Dealing with one task at a time
	Hierarchic	Dealing with multiple prioritized tasks
	Oligarchic	Dealing with multiple non-prioritized tasks
	Anarchic	Dealing with tasks at random
Levels	Global	Focusing on abstract ideas
	Local	Focusing on concrete ideas
Scopes	Internal	Enjoying working independently
	External	Enjoying working in groups
Leanings	Liberal	Using new ways to deal with tasks
	Conservative	Using traditional ways to deal with tasks

For design, collaboration means a process whereby team members work together, actively communicate to establish joint goals, explore through problem spaces, determine design constraints, and construct a design solution [10–12].

Interaction plays an important role in the collaborative design process. Does the thinking style influence the process and performance of collaborative design? Liao et al. [13] explored the relationship between team members' thinking styles and their performance in collaborative design. The Thinking Style Inventory was used to establish the thinking style profile of 20 undergraduate industrial design students participating in the experiment. The grades of the collaborative design projects implemented by the participants in a design studio course were also collected. The correlation coefficient of team members' thinking style profiles was calculated, and Pearson's correlation analysis was used to examine the relationship between project grades and team members' thinking style. Results demonstrated that the team members with different thinking styles had better performance in the collaborative design team. Laio [2] then conducted experimental collaborative design projects with the different thinking style types of the team members to verify the results. However, Laio only focused on the outcome of the project and did not discuss the behavioral differences of the design process. The present study, therefore, explores the differences in behavior on the design process of the different composition types of team members' thinking styles.

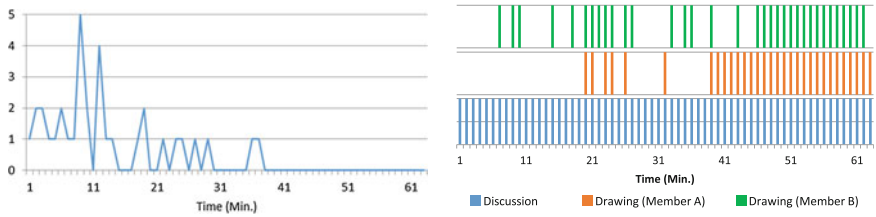
3 Method

This study explored the influences of team members' thinking style composition on behavior through collaborative design. The video of experimental collaborative design projects by Liao [2] was used as raw material and analyzed.

3.1 Experimental Collaborative Design Projects and Subjects

A nine-team video was selected from Liao's [2] study according to team members' thinking style composition. Teams were divided into three groups:

- *Group A* (*Ne-Cor*): the team members' thinking style profile was strongly negatively correlated (correlation coefficient < -0.6); this means the team members' thinking style was complementary.
- *Group B* (*No-Cor*): the correlation coefficient was very close to zero; this means there were no significant relationships between team members' thinking styles.
- *Group C* (*Po-Cor*): the team members' thinking style profile was strongly positively correlated (correlation coefficient > 0.6); this means the team members had a similar thinking style.



(A) (B)

Fig. 1 Sample of the number of concepts (**a**) and the coding of the discussion and drawing (**b**) through the design process

Each team had two members. A one-hour experimental design project was conducted to collect the data. Each team was asked to design a device to avoid oversleeping. Each design project took about 60 min.

3.2 Data Coding and Analysis

The content of the collaborative design projects' video was transcribed then coded and analyzed. The whole process timeframe was separated into minutes. The content of each minute was coded by discussion, concept generation, drawing, and writing when these behaviors were taking place. Figure 1 shows a sample of the number of concepts and the coding of the discussion and drawing behavior through the design process. A multi-coding strategy was adopted to code the behavior; therefore, when the team members performed the discussion and drawing at the same time, both behaviors were coded simultaneously.

4 Results

4.1 Numbers of Concept, Sketch, and Consensus

The average number of concepts generated, sketches, and consensus with different groups are presented in Fig. 2. The PO-COR group generated more concepts and sketches than other groups. The NE-COR group had the fewest number of concepts, but they had more consensus than the other groups.

The results demonstrated that the PO-COR group spent time generating the concept and sketch but possibly had different opinions on the design topic and problem and so struggled to find consensus. The number of concepts and sketches of the NE-COR group was equal to that of the NO-COR group, but their consensus was higher than the other groups. The team members of the NE-COR group appeared more appreciative of the other team member's contribution.

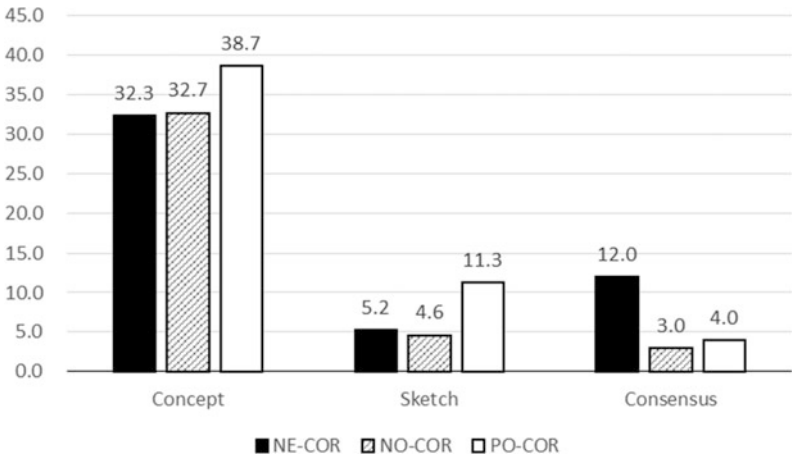


Fig. 2 The number of concepts, sketches, and consensus of each group

4.2 Time Consumption

Figure 3 presents the time taken for discussion, chatting, drawing, and writing in the design process. All groups spent a lot of time on the discussion, but the discussion time of the PO-COR group was lower than that of the other two groups. The NE-COR and NO-COR group also spent some time on chatting that did not relate to the design topic. The drawing time of the PO-COR group was highest, and the NO-COR group was lowest. The writing time of the NE-COR group was lower than the other groups.

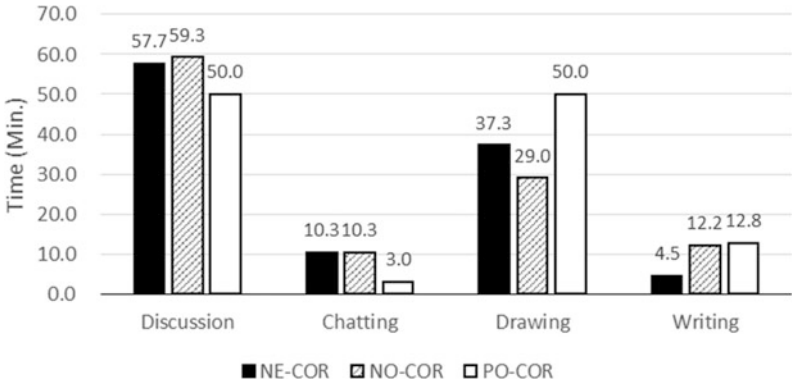


Fig. 3 The time spent on discussions, chatting, drawing, and writing for each group

The results demonstrated that the PO-COR team spent more time on drawing but less time on discussion, whereas the NO-COR team spent the most time on discussion and less time on drawing. The NE-COR team fell midway between the two.

4.3 Average Time of Concept Generation and Consensus

The average time of concept generation through discussion and drawing and the time to achieve consensus was calculated and is presented in Fig. 4.

The NE-COR and NO-COR groups on average spent 1.8 min to generate a concept through discussion. The PO-COR group took 1.3 min, suggesting that the PO-COR group can generate more concepts than the other groups. The average drawing time per concept was similar for the different groups; however, the average drawing time per concept of the NO-COR group was lower than the other two groups. The average time to achieve a consensus was different between the groups; the NE-COR group had the lowest average time, and the NO-COR group had the highest.

Based on the results, the NE-COR team had the most efficient discussions, while the NO-COR team had the lowest. Therefore, the NE-COR team could achieve consensus in a short time and so formulate the design direction and continually generate or derive new concepts or ideas. The NO-COR team needed more discussion time for achieving consensus. They were able to generate many concepts but could not agree on the direction of the ideation.

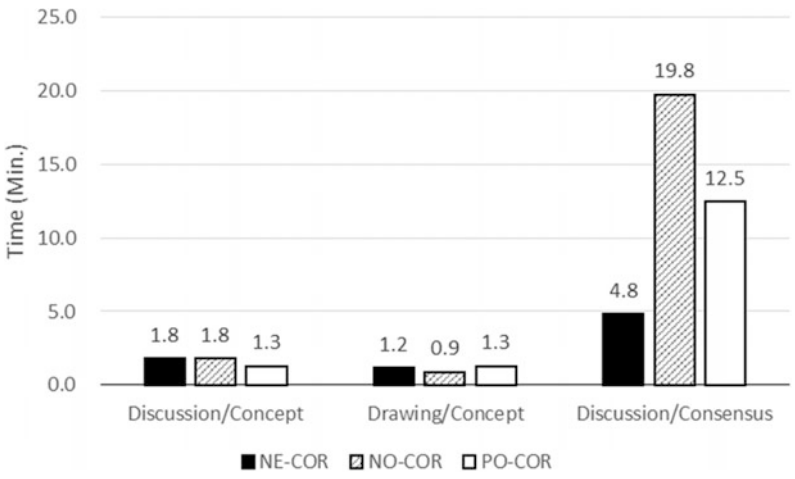


Fig. 4 Average time of concept generation within discussion and drawing, and the time to achieve consensus for each group

5 Concluding Remarks

Communication and interaction are important factors that impact the collaborative design process. A previous study [2] found the thinking style composition of team members affected the outcome of collaborative design projects. This study explored the behavior of different thinking style composition in the design process. The main findings were the following:

- In the PO-COR group, team members had a similar thinking style, generated more concepts, made decisions earlier, and spent a lot of time drawing the sketches. However, consensus was low.
- In the NO-COR group, there was no significant relationship in team members' thinking style; they took a long time for discussion and had difficulty achieving consensus.
- The NE-COR group had a negative thinking style composition, achieved more consensus, and continually developed concepts.

This study found different behaviors in the different thinking style composition of the design team in the collaborative design process. However, the sample size was small, and the coding only focused on behavior quantity. The results should be verified. The protocol analysis and Function-Behavior-Structure ontology model should be used to identify the pattern of behavior and increase the understanding of the collaborative design process.

References

1. Wang, S.-L., Lin, S.S.J.: The effects of group composition of self-efficacy and collective efficacy on computer-supported collaborative learning. Comput. Hum. Behav. **23**(5), 2256–2268 (2007)
2. Liao, C.-C.: Analyzing the influence of thinking styles on the performance of collaborative design. Master's thesis, Chang Gung University (2011) http://Handle.Ncl.Edu.Tw/11296/Ndltd/70048479629698062218
3. Tang, H.-H., Hsiao, G.-Y.: Exploring the relationship between the design content and the design results using FBS model. In: Green Future—the Proceedings of the 15th CID Annual Design Conference, pp. 1009–1014 (2010)
4. Tsai, A.-K., Tang, H.-H.: Exploring the relationship between the structure of design thinking process and design results using FBS model. In: Green Future—the Proceedings of the 15th CID Annual Design Conference, pp. 131–136 (2010)
5. Simon, H.A.: Search and reasoning in problem solving. Artif. Intell. **21**(1–2), 7–29 (1983)
6. Newell, A., Simon, H.A.: Computer simulation of human thinking and problem solving. In: Greenberger, M. (ed.) Management and the Computer of the Future, pp. 94–133. Wiley, New York (1962)
7. Todhunter, F.: Using concurrent think-aloud and protocol analysis to explore student nurses' social learning information communication technology knowledge and skill development. Nurse Educ. Today **35**(6), 815–822 (2015)
8. Akin, O.: An exploration of the design process. In: Cross, N. (ed.) Developments in Design Methodologies, pp. 189–208. Wiley, New York (1984)

9. Sternberg, R.J.: Thinking Styles. Cambridge University Press, Cambridge (1997)
10. Chiu, M.-L.: An organizational view of design communication in design collaboration. Des. Stud. **23**(2), 187–210 (2002)
11. Hennessy, S., Murphy, P.: The potential for collaborative problem solving in design and technology. Int. J. Technol. Des. Educ. **9**(1), 1–36 (1999)
12. Seitamaa-Hakkarainen, P., Lahti, H., Muukkonen, H., Hakkarainen, K.: Collaborative designing in a networked learning environment. In: Scrivener, S.A.R., Ball, L.J., Woodcock, A. (eds.) Collaborative Design, pp. 411–420. Springer, London (2000)
13. Liao, C.-C., Chen, W., Tang, H.-H.: Exploring the relationship between thinking style and collaborative design outcomes. In: Stephanidis, C. (ed.) HCI International 2011—Posters' Extended Abstracts, vol. 173, pp. 63–66. Springer, Berlin (2011)

Part XVII
Organizational Behavior and Development

Leadership Focus in Modern Expert Organization

Tero Reunanen and Marko Junno

Abstract Leadership is a concept proven troublesome to unambiguously define and its effectivity to assess in certain situations. There still is no clear consensus what leadership is. Nevertheless of academic discussions between different definitions, practical questions still arise and leadership is one of the most interesting research issues in organizations. What is the role of leadership in modern expert organizations and how do the leaders themselves experience it? How can it be measured and visualized? In this paper, we aim to find the leader's conscious awareness towards the different leadership competencies, by building the ontology for leadership focus and using it as the theoretical frame. Paper also presents the assessment of the model, and a survey utilizing creative tension, as tool to study the leader's competencies regarding leadership focus and enhancement needs of these competencies. Our findings show that while study itself gave positive results about the function of the survey and creative tension, it points out the needs for further development. The competence level self-evaluation part is revealing that even when there is possibility to create a realistic evaluation of the respondent's mind set towards his/hers leadership style in current situation, the research tool should be developed further when comparable magnitudes of answers are needed. Future research needs are also to be discussed in this paper.

Keywords Leadership · Focus · Situationality · Expert · Management · Competences · Organization

T. Reunanen (✉) · M. Junno
Turku University of Applied Sciences, Sepänkatu 1, 20700 Turku, Finland
e-mail: tero.reunanen@turkuamk.fi

M. Junno
e-mail: marko.junno@outlook.com

T. Reunanen
Tampere University of Technology, Pori Campus,
Pohjoisranta 11 A, 28100 Pori, Finland

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1 Introduction

Good leadership is like good quality; we can recognize it when we see it. But just as quality, leadership can be difficult to define unambiguously. Whether it actually exists or can its effectiveness be defined, is still much debated in the organizational behavior discussion [1–5].

The idea for this study was triggered by the wide discussion about the meaning and effectiveness of leadership in general. Former study which was executed in 1997–2014 regarding 239 Finnish SME companies, found leadership to be the most important inner organizational factor which has a direct impact on companies' outcomes [6]. Example from a large company, Nokia, shows that fears in middle and top-management led to a loss of leadership and resulted degeneration in innovation capability. This led to rapid downfall from market dominant and innovative organization to company which just lost the game [7].

The purpose of the study was to find out how well the set of propositions, regarding leadership focus domain of the management windshield [8, 9], can reveal leadership competences and enhancement needs regarding leadership style. To evaluate the most significant leadership competencies with the tool, all the competences were broken down to factors and then propositions were created to best describe those factors. The respondent self-evaluated their own leadership competencies, by answering the propositions. These answers were analyzed by the researchers. Leadership focus ontology were built by literature review in order to make a visual upper level map to show what scholars have said about leadership style and what the concept of leadership comprises. Particularly how it should be approached, and whether it has an effect on organizational outcome and if so, how it can be measured. For this reason, the metaphor of the managerial windshield [8, 9] was chosen to represent the frame for this study.

The concept of leadership and a classification of major leadership approaches: (1) trait (2) behaviour (3) power-influence (4) situational and (5) integrative approaches [5], is used. Focus needs of leadership is studied from its situational nature. Leadership focus comprises such leadership theories and skills as transactional leadership, transformational leadership, servant leadership and emotional intelligence [8, 9].

2 Leadership Definitions

"*Leadership is one of the world's oldest preoccupations*" [10]. The history of scientific leadership research starts in the twentieth century and could be timed to an era of management boom after World War II, but it has been the interest of humankind since the beginning of recorded history [11]. In the context of organizational behaviour, leadership has been defined in numerous ways. According to Stogdill [12] "*there are almost as many definitions of leadership as there are persons who*

have attempted to define the concept". Glynn and DeJordy [13] found that Harvard Business Review alone has published around 500 articles that reference leadership in their abstract. The consensus of the meaning of leadership still remains mostly unachieved. There is work done towards consensus, e.g. Mackenzie and Barnes [14] found seven items: (1) leadership is a good thing and more of it is better, (2) leaders are presumed to be rational actors, (3) leaders tend to be solid citizens, (4) leaders do not actually perform work, (5) leaders do not manage technologies, (6) a measure of leadership is leadership itself, and (7) organizational place is not important. Researches tend to define leadership mirroring their own interests to the phenomenon. New definitions of leadership have been done since Stogdill made his observation [5]. Leadership literature includes, but is not limited to, these exemplars: Katz and Kahn [15] defined leadership as "*the influential increment over and above mechanical compliance with the routine directives of the organization*", where Hersey and Blanchard [16] defined it as "*leadership is the process of influencing the activities of an individual or a group in efforts toward goal achievement in a given situation*", and later "*..leadership occurs whenever one person attempts to influence the behaviour of an individual or group, regardless of the reason*" [17]. Bass and Stogdill [10] takes a broader approach to the definition of leadership by stating: "*leadership is an interaction between two or more members of a group that often involves a structuring or restructuring of the situation and the perceptions and expectations of the members. Leaders are agents of change—persons whose acts affect other people more than people's affect them. Leadership occurs when one group member modifies the motivation or competencies of others in the group—with this broad definition, any member of the group can exhibit some amount of leadership, and the members will vary in the extent to which they do so*". Pardey states that "*Leadership is something that people see or experience personally. It is above all about the relationship between the leader and those people being led*" [18]. Because of the vast amount of different definitions of leadership and so many different meanings to people, some theorists and critics argue that the effects of leadership might not exist at all [1]. Meindl et al. [2] were either not able to generate common view towards leadership that would have been both "intellectually compelling" and "emotionally satisfying". Alvesson and Sveningsson [3] argued that leadership could be non-existent as distinct phenomenon.

Although most drastic critics tend to point out that leadership is no more than a romanticized illusion, [2] most organizational behavioural scientists seem to consider it real phenomenon which impacts on the organizational effectiveness [5]. Mackenzie and Barnes [14] stated that "*interest in the phenomena of leadership knows no geographical, political, or temporal boundaries. Leadership is widely acknowledged to be important to groups, organizations, and even societies.*" Despite the fact that external forces can impact the performance of an organization, they still attribute success to good leadership and failure to poor leadership. Leaders make difference and social and political movements and seem to be the most critical factor in the success in business and industrial sector [10]. If the competence of leadership is lacking, it seems to be the single most remarkable barrier when increasing the productivity of companies [6].

2.1 Leadership Approaches

Broader theoretical milieu of every time period had naturally influenced leadership theories as well as major events or specific needs of time in which the theoretical models have been developed [13]. There are many ways to classify and organize leadership theories and approaches. Yukl's [5] classification provides means to classify leadership according to most emphasized variable e.g. characteristics of leader, follower or situation. Key variables by, Yukl [5] is divided the leadership approaches (1) trait, (2) behavior, (3) power-influence, (4) situational and (5) the integrative approach. Traits alone don't guarantee the success as leader, [10, 13] and attention was set to what the managers actually do when working i.e. behavior [5]. Behaviour of people was seen to be stable, but lack of situationality urged to develop situation specific approaches [13]. Power-influence approaches underline that power influence much in relations, not only between subordinates, superiors and peers, but also others outside the organization e.g. customers or partners. The amount way to use power determines effectiveness of leadership [5]. A great leader is seen as a result of time, place and circumstance (check also definition for experienced time [9] and Kairos time [19]). The leaders should possess a toolbox for behavioral styles and other leadership attributes, which could be used adaptively depending on the situation. [10, 13] Integrative approaches includes several types of leadership variables in the same approach [5]. The leadership research focus has shifted from the significance of decision-making to the significance of economic performance in the last fifty years [20]. This is seen in approaches also and other ways to classify the theories and approaches [21]. Mackenzie and Barnes [14] found consensus between 11 approaches. Dinh et al. [22] identified a 66 different leadership theory domains in their review research.

Transactional and transformational leadership was first introduced by Burns [23]. Bass described transactional leadership as "a relationship between leader and follower to meet their own self-interests" [24]. Transactional leadership is an approach which is based on trading between the leader and the follower, where the follower's needs are satisfied and work performance for leader is achieved in return [25]. Transactional leadership doesn't highlight or appreciate values, although it may involve issues such as honesty, fairness, reciprocity and responsibility. These values are relevant only in the exchange process [5]. For transactional leadership competency assessment, this study utilizes four forms or factors: (1) contingent reward (clarifying negotiating and use of material and psychic rewards) [5, 24, 26, 27], (2) active management-by-exception (actively monitoring and tracking errors in order to take initiative action to prevent errors) [5, 24, 26, 27], (3) passive management-by-exception (focus is on failures, includes corrective actions, but only after the deviations from the desired performance.) [5, 24, 27] and (4) laissez-faire (the absence of leadership, actually a non-leadership approach) [5, 24, 27, 28].

In transformational leadership work is done towards a certain common goal that represented both leaders and followers [23]. One of the definitions is that it is "the

product of past experience to future course of action through innovative ideas, views and intellect" [29]. Transformational leadership is a manageable process to change followers' self-vision. Transformational leaders are capable in turning followers to leaders by making them to go further from their own needs towards the good of the organization [5, 10, 30]. Transformational leadership can be seen as one of the most effective approaches in organizational change and it can have a positive impact on follower's commitment towards change [31]. The 5 forms (1) idealized influence attributes [24, 28] (2) idealized influence—behavior [24, 28], (3) inspirational motivation [24, 28], (4) intellectual stimulation, [24, 26, 28] and (5) individualized consideration interest towards followers [24, 28, 32], of transformational leadership are utilized in assessing the levels of transformational competences in this study. Alternative five levels could be found from e.g. Maxwell: (1) Position, (2) Permission, (3) Production, (4) People development and (5) Pinnacle [33], but former ones are chosen to be utilized because their closer nature compared to competences. Adaptive leadership was formulated by Heifetz and extends leading beyond routines and procedures. Adaptive leadership approach deepened the view from leading in difficult situations and adaptive problem solving [34]. Since it is an insufficient approach for leadership focus purposes and most of it is included also in transformational leadership, it was not regarded in the questionnaire of this study, even than it is situated to ontology between transactions and transformation.

Servant leadership firstly introduced in by Greenleaf with statement: "True leaders are chosen by their followers [35]. Servant leadership in organizations puts the followers' needs first and helping them to reach goals. This could result in better atmosphere and service in the organization, but doesn't automatically improve performance [36]. Servant leader builds an environment that serves the needs of the followers and enables them grow and develop, and encourages them to take new responsibilities. A servant leader focuses on long-term relationship building with followers [5, 37]. Ten characteristics that well describe a servant leader: listening, empathy, healing, awareness, persuasion, conceptualization, foresight, stewardship, commitment and building community [21]. Compassionate love or just compassion in organizations could also be linked to servant leadership [38]. The research on servant leadership is still limited [5] and criticism towards it has also been set that it is too vague to be its own approach [14]. The seven distinguishable factors of servant leadership could be set as: (1) conceptual skills, (2) empowerment, (3) helping subordinates to grow and succeed, (4) putting subordinates first, (5) behaving ethically, (6) emotional healing and (7) creating value for the community [37].

Emotional intelligence (EI) was introduced in mid-90s [39] and it is rather is a managerial competency model than a leadership theory [5] EI is described as individual's ability to identify, understand and control his/her own emotions and recognize these in others [40]. An emotionally intelligent leader is skilled in self-awareness, self-management, social awareness and skills, empathy and motivation [5, 41]. Ethics and morality are stated to missing from EI model [42]. Also criticism for the reliability of the whole model has been raised [43]. Besides of critics the model is seen as one of the promising models [44], it is utilized in this study. There are 4 major factors, 18 sub-factors. These are: (1) self-awareness, with

sub-factors: emotional self-awareness, accurate self-assessment and self-confidence, (2) self-management, with sub-factors: self-control, transparency, adaptability, achievement, initiative and optimism, (3) social-awareness, with sub-factors: empathy, organizational awareness and service, and (4) relationship-management, with sub-factors: inspiration, influence, developing others, change catalyst, conflict management and teamwork and collaboration [41, 45].

2.2 *Ontology for Leadership Focus*

Hence we are able to introduce Leadership focus ontology. As seen Leadership focus ontology consists of 5 different issues for leaders to focus on at upper level. These issues are transactions, adaptions, transformation, servant, and emotional intelligence. All of these are linked to the conscious awareness of holistic manager whose origin is in Holistic concept of man [46]. Conscious awareness from oneself i.e. managing oneself is the starting point for all good managers [47] (Fig. 1).

As a result, Management windshield, firstly introduced by Vanharanta [8] and further developed by Reunanen [9], consists of now also leadership focus ontology. And because The Management windshield consists of only upper-level knowledge model of leadership and management ontologies strengthened with time ontology, it should not be considered to possess all different possible options of managers' focuses, but upper level approaches. Research part of this paper clarifies more about sub-factors of these approaches.

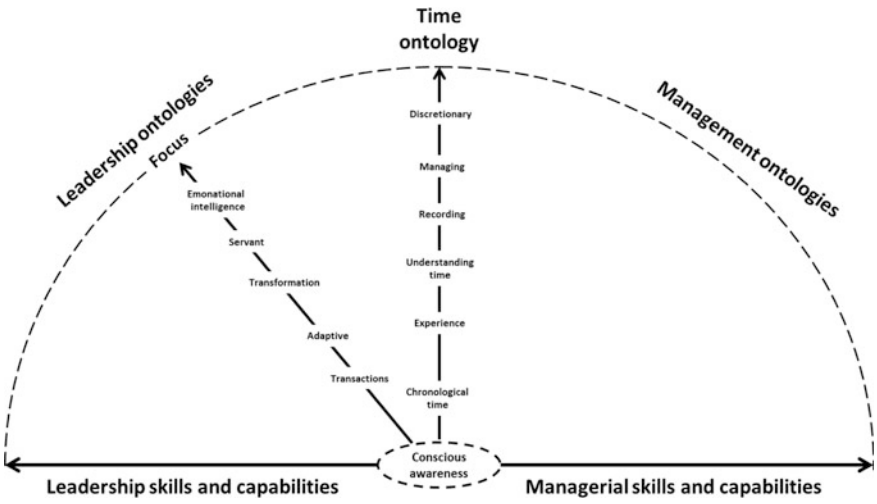


Fig. 1 Leadership focus ontology situated in management windshield metaphor

3 Research Setting

3.1 Data Collection

The main approach and mind set for this study is Evolute approach by, applying ontology engineering, precisiation of meaning, and usage of soft-computing methods and fuzzy logic in order to found out what is and how to cope with uncertainty and imprecision in human knowledge inputs [48]. This study is based on a quantitative research and the research data was acquired by using a structured survey questionnaire, with Webropol. The propositions were derived to the questionnaire from the factors of leadership theories and focused on consisting the competencies of transactional leadership, transformational leadership, servant leadership and emotional intelligence, each theory and competency was opened to factors and sub-factors totally creating 30 propositions. These factors then profiled each theory and competence, so that they could be measured using in a self-assessing structured questionnaire. In addition to the propositions drawn from the factors, demographic questions were put to the questionnaire to gather data for statistical purposes from the respondents. These questions comprised age, gender, education, leadership experience in years, leadership education and voluntary contact details.

Each proposition was divided into two parts to assess the respondent's current status, the present level, and target status, desired level. Therefore respondents answered to each proposition twice. This revealed the respondents' creative tension i.e. direction and magnitude for development need by showing the difference between the target and current status. This creative tension can be thought as competency gaps. Answer scale was Likert scale and all answers were handled as integers between 1 and 6.

The target organization of the research was the Turku University of Applied Sciences Faculty of Technology, Environment and Business. The online questionnaire was sent to 27 recipients from Turku University of Applied Sciences Faculty of Technology, Environment and Business steering group. Recipients contained dean, Education and Research Managers and Leaders. All together 11 answers were got in asked timeframe.

3.2 Data Analysis

The gathered data was quantitatively analyzed partially using Webropol Professional Statistics tool, IBM SPSS statistics tool and Microsoft Excel. SPSS was used in finding the Pearson's and Spearman's correlations and Microsoft Excel was used then to count the number of statistically significant correlations, as illustrated in Table 1.

Table 1 Percentages of correlation between all respondents

Tested cases	Positive correlation $p < 0.01$ (%)	Positive correlation $0.01 < p < 0.05$ (%)	Non-significant correlation $p \geq 0.05$ (%)	Negative correlation $p < 0.01$ (%)	Negative correlation $0.01 < p < 0.05$ (%)
Current state Pearson's analysis	7.3	10.9	78.2	0	3.6
Target state Pearson's analysis	5.5	16.4	78.2	0	0
Competency gap Pearson's analysis	5.5	16.4	78.2	0	0
Current state Spearman's analysis	7.3	10.9	80.0	0	1.8
Target state Spearman's analysis	5.5	12.7	78.2	0	0
Competency gap Spearman's analysis	3.6	16.4	80.0	0	0

The research data consisted of all 11 respondents' 65 answers: each respondent giving 30 answers of the current state, 30 answers of the target state, and five answers concerning demographic questions. This resulted altogether in 660 different variables. To find out whether the gaps in the current and target states correlated, a correlation gap variable was calculated from their difference in every answer. Demographic data, as gender and accomplished leadership courses and certifications, were not used in this study, but they were gathered due to possible future study.

The statistical significance of correlations in every case was tested against the null hypothesis, which was the assumption that correlation exists between the respondent's answers. All cases were analyzed using Pearson's product-moment correlation for its linear nature and also Spearman's rank correlation which is a monotonic relationship coefficient and less restrictive than the linear coefficient. All answers from all respondents were compared with all other answers from all respondents.

4 Results

The results of the study were at the same time expected, interesting and vague. As expected, there are positive correlations between the respondents answers and the leaderships focus factors that were used in this study. Table 1 illustrates all the

cases that were tested in this study. The first column represents the highly significant positively correlating answers and their percentage of all possible comparisons, the second column represents the significant positively correlating answers, third column represents the non-significant correlation in answers, fourth column represents the highly significant negatively correlating answers and the fifth represents the negatively correlating answers.

As illustrated in Table 1, there seems to be some amount of statistically significant positive correlation between all answers of all respondents. Although, the amount of highly significant positive correlation is quite low, the significant positive correlation compensates it. Both, the Pearson's and the Spearman's analysis of the current state show a total of 18.2 % of significant positive correlation between all answers from all respondents. In target state Pearson's analysis, the total positive correlation is 21.9 % and in Spearman's analysis 18.2 %. In competency gap analysis, Pearson's analysis gives 21.9 % and Spearman's analysis 20.0 % of positive correlation. Although the non-significant correlation if fairly high, over 78 %, in all cases, it does not mean there is no correlation. Correlation can be found in most answers between the respondents, but it just cannot be declared statistically significant. Also, there is very little significant negative correlation between the answers. Only current state Pearson's analysis gives 3.6 % and current state Pearson's analysis gives 1.8 % of negative correlation. The rest the answers have no significant negative correlation. All this implies that the factors and respondents' answers correlate positively well.

The diagram in Fig. 2 shows means of all answers to propositions of this study. Diagram is consorted so that above every numbered proposition there are current state and target state for each proposition. Diagram also shows creative tension in group

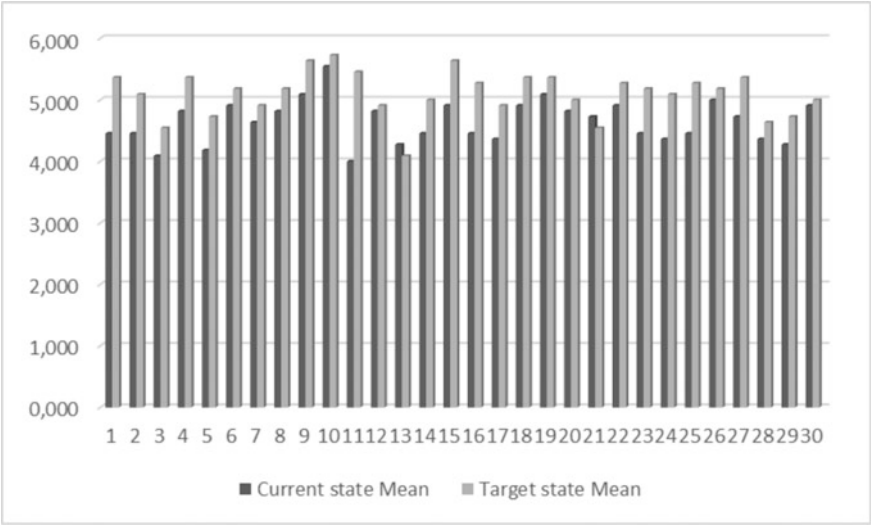


Fig. 2 Mean values for propositions

via differences between current and target status. Propositions 1–4 are the transactional leader-ship factors, 5–9 are transformational leadership factors, 10–13 are servant leadership factors and 14–30 are emotional intelligence leadership factors.

As can be seen from Fig. 2. the most of the respondents evaluate their competencies to be on a high level regardless of their age, education or leadership experience. This implies that the questionnaire used in the study may not be ideal and it may lead the respondent to answer in a certain manner. One major reason may also be the difficulty of self-evaluation although some researchers imply that it could be done effectively and it can be learned and improved [49]. Parallel to that, all of the respondents were long-term professional with the average experience of 16 years on leadership and management which supports the confidence of respondents' skills.

5 Conclusions

The purpose of this study was to examine the feasibility of building a survey tool to get reliable results about the respondent's leadership competencies regarding leadership focus. The competencies themselves were derived from the leadership focus domain of the management windshield. The study was conducted by first building an ontology for leadership focus, based on the findings of the literature research. From this research a set of best describing propositions were created to build a survey tool in order to evaluate the respondent's point of view towards their focus.

The survey was executed by sending it to 27 of the leaders in Turku University of Applied Science's Faculty of Technology, Environment and Business. Eleven of the recipients, consisting of dean, education and research managers and leaders, answered the survey. Although the sample size was not very reliable yet, the survey was founded to be usable, although some reliability issues were found, which should be addressed in possible later studies. There is good amount of positive correlation in tested factors and a clear gap between the positive and the negative correlations. Most of the assessed factors of the respondents were somewhat homogenous and there was low deviation from the average levels of factors. This implies a reasonable trust in the survey tool. Another side is the actual reliability of the results of the survey. The rather small sample size can also be seen problematic and while the creative tension in factors were positive as expected, there was also negative tension. That might indicate that some propositions may easily be misinterpreted or they are not assessing the factor correctly. Also, the low number of propositions per factor available in this study can be seen as reliability issue.

Judging by these research results, there definitely is a need for future research on leadership through the leadership focus of the management windshield. The number of factors and especially the number of propositions describing the factor is to be improved. The respondent might be led to answer the propositions in an eagerly positive manner, thus not reflecting the true essence of their leadership capabilities.

Also, the use of interviews and other suitable qualitative research methods combined may give better possibility to an in-depth evaluation of the leader's focusing capabilities. The interview could take place directly after the survey and concentrate on propositions with the respondent to really get an understanding about the answers and complement the data acquired with the survey. Another usable approach may be that the respondent could be interviewed in a more in-formal way to give possibilities to explain the need with their own words. Also, a 360-type of approach, where the respondent's peers, followers and superiors would be asked to evaluate respondent, if the reliability of self-evaluation is seen insufficient.

Another issue for future research would be the coverage of the theoretical model of leadership focus. Even that the research coverage of the leadership focus domain is already quite extensive, more research may be needed, especially in order to found combinations and relations of leadership focus domain with other leadership domains.

References

1. Kerr, S., Jermier, J.M.: Substitutes for leadership: Their meaning and measurement. Organ. Behav. Hum. Perform. **22**(3), 375–403 (1978)
2. Meindl, J.R., Ehrlich, S.B., Dukerich, J.M.: The romance of leadership. Adm. Sci. Q., 78–102 (1985)
3. Alvesson, M., Sveningsson, S.: The great disappearing act: Difficulties in doing "leadership". Leadersh. Q. **14**(3), 359–381 (2003)
4. Bligh, M.C., Kohles, J.C., Pillai, R.: Romancing leadership: Past, present, and future. Leadersh. Q. **22**(6), 1058–1077 (2011)
5. Yukl, G.A.: Leadership in Organizations, 8th edn. Pearson, Boston (2013)
6. Rantanen, H., Rantala, T., Pekkola, S.: Tuottavuuden kehittämisen esteet - suomi eilen ja tänään (Research Report No. 38). Lappeenrannan teknillinen yliopisto, Yliopistopaino 2015: Lappeerannan teknillinen yliopisto (2015)
7. Vuori, T.O., Huy, Q.N.: Distributed attention and shared emotions in the innovation process: How Nokia lost the smartphone battle. Adm. Sci. Q., 1–43 (2015)
8. Vanharanta, H.: The management windshield: An effective metaphor for management and leadership. AHFE International Conference, 14–17 July 2008, Las Vegas, Nevada, USA (2008)
9. Reunanen T.: Human factor in time management. Procedia Manufacturing, vol. 3, pp. 709–716. Elsevier (2015)
10. Bass, B.M., Stogdill, R.M.: Bass & Stogdill's Handbook of Leadership: Theory, Research and Managerial Applications, 3rd edn. The Free Press, New York (1990)
11. Drucker, P.: Management. Tasks, responsibilities, practices. Truman Talley Books, E. P. Dutton, New York (1986)
12. Stogdill, R.M.: Handbook of Leadership: A Survey of the Literature. Free press, New York (1974)
13. Glynn M.A., DeJordy, R.: Leadership through an organization behavior lens. A look at the last half-century of research. In: Nohria, N., Khurana, R. (eds.) Handbook of Leadership Theory and Practice: An HBS Centennial Colloquium on Advancing Leadership, pp. 119–156 (2010)
14. Mackenzie, K.D., Barnes, B.F.: The unstated consensus of leadership approaches. Int. J. Org. Anal. **15**(2), 92–118 (2008)

15. Katz, D., Kahn, R.L.: The Social Psychology of Organizations, 2nd edn. Wiley, New York (1978)
16. Hersey, P., Blanchard, K.H.: Management of Organizational Behavior: Utilizing Human Resources. Prentice-Hall, New Jersey (1988)
17. Hersey, P., Blanchard, K.H., Johnsson, D.E.: Management of organizational behaviour. Leading Human Resources, Prentice-Hall, New Jersey (2001)
18. Pardey, D.: Introducing Leadership. Elsevier, UK (2007)
19. Czarniawska, B.: On time, space and actions nets. Organization **11**, 773–791 (2004)
20. Podolny, J.M., Khurana, R., Hill-Popper, M.: Revisiting the meaning of leadership. Res. Organ. Behav. **26**, 1–36 (2005)
21. Avolio, B.J., Walumbwa, F.O., Weber, T.J.: Leadership: Current theories, research, and future directions. Annu. Rev. Psychol. **60**(1), 421–449 (2009)
22. Dinh, J.E., Lord, R.G., Gardner, W.L., Meuser, J.D., Liden, R.C., Hu, J.: Leadership theory and research in the new millennium: Current theoretical trends and changing perspectives. Leadersh. Q. **25**(1), 36–62 (2014)
23. Burns, J.M.: Leadership. Harper & Row, New York (1978)
24. Bass, B.M.: Two decades of research and development in transformational leadership. Eur. J. Work Organ. Psychol. **8**(1), 9–32 (1999)
25. Deichmann, D., Stam, D.: Leveraging transformational and transactional leadership to cultivate the generation of organization-focused ideas. Leadersh. Q. **26**(2), 204–219 (2015)
26. Avolio, B.J., Bass, B.M., Jung, D.I.: Re-examining the components of transformational and transactional leadership using the multifactor leadership. J. Occup. Organ. Psychol. **72**(4), 441–462 (1999)
27. Judge, T.A., Piccolo, R.F.: Transformational and transactional leadership: A meta-analytic test of their relative validity. J. Appl. Psychol. **89**(5), 755–768 (2005)
28. Greiman, B.C.: Transformational leadership research in agricultural education: A synthesis of the literature. J. Agric. Educ. **50**(4), 50–62 (2009)
29. Chaudhuri, M.R., Kettunen, J., Naskar, P.: Transformational and servant leadership: Evidence from indian higher education. Online J. Qual. High. Educ. **2**(4), 93–101 (2015)
30. Tse, H.H.M., Chiu, W.C.K.: Transformational leadership and job performance: A social identity perspective. J. Bus. Res. **67**(1), 2827–2835 (2014)
31. Tyssen, A.K., Wald, A., Spieth, P.: The challenge of transactional and transformational leadership in projects. Int. J. Project Manag. **32**(3), 365–375 (2014)
32. Avolio, B.J., Bass, B.M.: Multifactor leadership questionnaire. Manual and Sampler Set, 3rd edn. (2004)
33. Maxwell, J.C.: 5 Levels of Leadership: Proven Steps to Maximize Your Potential. Center Street, New York (2011)
34. Heifetz, R.: Leadership Without Easy Answers. Press of Harvard University Press, Cambridge (1994)
35. Greenleaf, R.K.: The Servant as Leader (1970)
36. Hunter, E.M., Neubert, M.J., Perry, S.J., Witt, L.A., Penney, L.M., Weinberger, E.: Servant leaders inspire servant followers: Antecedents and outcomes for employees and the organization. Leadersh. Q. **24**(2), 316–331 (2013)
37. Liden, R.C., Wayne, S.J., Zhao, H., Henderson, D.: Servant leadership: Development of a multidimensional measure and multi-level assessment. Leadersh. Q. **19**(2), 161–177 (2008)
38. van Dierendonck, D., Patterson, K.: Compassionate love as a cornerstone of servant leadership: An integration of previous theorizing and research. J. Bus. Ethics **128**(1), 119–131 (2015)
39. Goleman, D.: Emotional Intelligence. Bantam Books, New York (1995)
40. Bradberry, T., Greaves, J.: Emotional intelligence 2.0. Talent Smart, San Diego (2009)
41. Goleman, D., Boyatzis, R., McKee, A.: Primal leadership: The hidden driver of great performance. Harvard Business Review, vol. 79, no. 11 (2001)
42. Segon, M., Booth, C.: Virtue: The missing ethics element in emotional intelligence. J. Bus. Ethics **128**(4), 789–802 (2015)

43. Virtanen, M.: Teachers emotional competency: A research of teachers and students emotional intelligence competencies and its importance. Doctoral dissertation, Tampere University Press, Tampere (2013)
44. Føllesdal, H., Hagtvet, K.: Does emotional intelligence as ability predict transformational leadership? A multilevel approach. Leadersh. Q. **24**(5), 747–762 (2013)
45. Goleman, D., Boyatzis, R., McKee, A.: Primal leadership: Realizing the power of emotional intelligence. Harvard Business Review, Harvard Business School Press (2002)
46. Vanharanta, H., Pihlanto, P. Chang, A.M.: Decision support for strategic management in a hyper-knowledge environment and the holistic concept of man. Proceedings 30th Annual International Conference on Systems Sciences, pp. 243–258, Hawaii (1997)
47. Drucker, P.F.: Managing oneself. Harvard Business Review, vol. 83, no. 1, pp. 100–109 (2004)
48. Kantola, J.: Organizational Resource Management: Theories, Methodologies, and Applications. CRC Press, Boca Raton (2015)
49. Yliruka, L.: Self-evaluation as a reflective structure. Workability, Adaptation and Development of the Mirror Method. Helsingin yliopisto, Helsinki (2015)

An Organizational Activity Framework for Effective Business Practices Implementation in Research-Oriented Organizations in Developing Economies

Mohammed-Aminu Sanda

Abstract This paper explored the constraints to business practices implementation by Research-Oriented Organizations in Developing Economies. Guided by organizational activity, sociotechnical and macroergonomic theories, data was collected from four research-oriented organizations in four developing countries, and analyzed using actions of identified groups in each organization's activity system as the unit of analysis. It was found that the emergence of multivoicedness in the organizations' activity systems created misfits among the organizations components which created systemic problems, ruptures, and breakdowns which constrained the effectiveness of the organizations' business practices implementations. It is concluded that in the process of business practices implementation, an activity in the organization must be understood not as one activity with its peculiarities, but rather as a real aggregate of several activities and relations arising from the interacting components of the organization. A framework for understanding effective business practices implementation in research-oriented organizations is thus formulated.

Keywords Organizational activity · New business practices · Practices implementation · Research-oriented organization · Developing economy

1 Introduction

Small and Medium-Scale Enterprises (SMEs) have been recognised as critical in the economic and social development of most countries. They are especially important for their role in job creation with low investment, regional development, as suppliers to large companies, entrepreneurship development, and in for new technology-based firms, innovation of new products and processes. In many

M.-A. Sanda (✉)
University of Ghana Business School, P.O. Box LG 78, Legon, Accra, Ghana
e-mail: masanda@ug.edu.gh; mohami@ltu.se

M.-A. Sanda
Luleå University of Technology, SE 97187 Luleå, Sweden

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instances, SMEs are assisted by Research and Development Organizations (RDOs). The RDOs provide technical and business extension services, testing facilities, problem solving services as well as Research and Development assistance to SMEs. It has been recognized by [1] that the ability of RDOs to serve SMEs effectively is an important determinant of the success of SMEs in meeting the competitive challenge of the marketplace. According to [1], it is clear that, irrespective of government policies, SMEs cannot attain their full potential without improvements in their ability to access, absorb, adapt, and exploit new technologies and business techniques. In this context, RDOs can play an important role in making this happen. However, they must provide services to SMEs with the highest level of effectiveness and efficiency to best enhance SME capacity to innovate and ultimately to improve their competitiveness and sustainability [1].

Studies of RDO functions by Mengu and Grier [1] in the European Union and elsewhere revealed a great deal of consensus regarding their underlying business principles and the practices used in their daily interaction with client enterprises. The tools developed have targeted RDOs that provide technical and business extension services, testing facilities, problem-solving services and research and development assistance to industry, especially those in the SME sector. A study by [2] on the implementation of these management tools among ten RDOs in eight countries from Africa, Asia, South America and the Caribbean showed that most of them were unsuccessful in their ability to implement and internalize management practices. This observation raised the question as to whether the implementation constraints encountered by the RDOs were a direct consequence of internal factors associated with their organizational activity systems. Therefore, the purpose of this paper is to understand whether the implementation constraints encountered by the organizations was a direct consequence of factors in the organizations organizational activity systems and how such understanding could be used to develop remedies for mediating such constraints.

2 Literature Review

The very survival of organizations, according to [3], depends on their ability to adapt to their external environment. In terms of open systems theory, organizations require monitoring and feedback mechanisms to be able to follow and sense changes in their relevant task environments and a capacity to make responsive adjustments. Relevant task environments refer to that part of the firm's external environment that can positively or negatively influence the organization's effectiveness (i.e. the organization's critical constituencies). It is established by [3] that relevant task environments are different for each organization with respect to type, qualitative nature, and importance. The particular weighted combination of relevant

task environments constitutes its specific task environment. A major determinant of an organization's specific environment is its domain, or the range of products or services offered, and market share [4]. Domain is important, because it determines the point at which the organization depends on its specific task environment [5]. A second determinant of an organization's specific task environment is its stakeholders [3]. These include the firm's stockholders, lenders, members of the organization, customers, users, governmental agencies, and the local community, each of which has an effect in the organization.

2.1 Organizational Design and Management Consequences

It is noted by [6] that organizational hierarchy and the down-flow of authority within organizations are common practices in industrially developing countries and such values as democracy, empowerment, or power sharing in decision-making, which are regarded as key issues in modern management for proper utilization of human resources (with regard to intelligence, creativity, problem-solving potential, and ingenuity), do not agree with the cultural sense of hierarchical power. According to [6], an organization is a social structure wherein employees play a decisive role in improving its performance. Furthermore, 'decision-making and action should be concentrated in the heart of the operation to reduce the risk and duration of system failure and to better utilize resources as well as increase system reliability and availability' [6]. Since organizational change is a difficult, time consuming, and expensive process, [7] noted that cultural factors, including the way people interact with each other in an organization and commit themselves to organizational goals, are complex matters that have significant bearing on the success of an organizational change. In this respect, [6] indicated the necessity of matching management methods and techniques to the local conditions. According to [6], societal and organizational culture-based differences should be considered when introducing change in an organization.

2.2 Organizational Activity Theory Perspectives

It is explained by [8] that in activity theory, developmental transformations are seen as attempts to reorganize, or re-mediate, the activity system in order to resolve its pressing inner contradictions. While the primary contradiction between the use value and exchange value of the object does not go away, it evolves and takes the form of specific secondary contradictions as the activity system interacts with other activity systems [8]. The emergence, aggravation and resolution of these secondary

contradictions may be regarded as a developmental cycle in the life of the activity system [9]. Thus work activities undergo transformations which sometimes lead to expansive reorganization. According to [10], the distinction between individual goal-directed action and collective object-oriented activity is of central importance. Individual actions may be depicted focusing on their linear dimension or focusing on their socio-spatial dimension. In any case, the temporal duration of actions is relatively short. Activity theory has been summarized by [10] with the help of five principles - The first principle postulates that a collective, artifact-mediated and object-oriented activity system, seen in its network relations to other activity systems, is taken as the prime unit of analysis. Goal-directed individual and group actions, as well as automatic operations, are relatively independent but subordinate units of analysis, eventually understandable only when interpreted against the background of entire activity systems. Activity systems realize and reproduce themselves by generating actions and operations. The second principle is the multivoicedness of activity systems. An activity system is always a community of multiple points of view, traditions and interests. The division of labour in an activity creates different positions for the participants, the participants carry their own diverse histories, and the activity system itself carries multiple layers and strands of history engraved in its artifacts, rules and conventions. The multivoicedness is multiplied in networks of interacting activity systems. It is a source of trouble and a source of innovation, demanding actions of translation and negotiation. The third principle is historicity. Activity systems take shape and get transformed over lengthy periods of time. Their problems and potentials can only be understood against their own history. History itself needs to be studied as local history of the activity and its objects, and as history of the theoretical ideas and tools that have shaped the activity. Thus, implementation of the management benchmark needs to be analyzed against the history of its local organization and against the more global history of the organizational concepts, procedures and tools employed and accumulated in the local activity. The fourth principle is the central role of contradictions as sources of change and development. Contradictions are not the same as problems or conflicts. Contradictions are historically accumulating structural tensions within and between activity systems. This primary contradiction pervades all elements of our activity systems. Activities are open systems. When an activity system adopts a new element from the outside (for example, a new technology or a new object), it often leads to an aggravated secondary contradiction where some old element (for example, the rules or the division of labour) collides with the new one. Such contradictions generate disturbances and conflicts, but also innovative attempts to change the activity. The fifth principle proclaims the possibility of expansive transformations in activity systems. Activity systems move through relatively long cycles of qualitative transformations. As the contradictions of an activity system are aggravated, some individual participants begin to question and deviate from its established norms. In some cases, this escalates into collaborative envisioning and a deliberate collective change effort.

3 Methodological Issues

3.1 Data Collection Procedure

The empirical approach for this study has involved the collection of data from multiple sources on how activities are carried out by agents in RTOs from Ghana, Botswana, Trinidad and South Africa. Firstly, the questioning process from the perspectives of structured interviews with key actors in the organization (i.e. staff members with deep insights of events which might have occurred during the implementation exercises) was conducted. Secondly, personal observations were made on the ways various activities are carried out and how actors carrying them interact with one another. Thirdly, a participatory problem identification workshop [11–13] was conducted to develop an overview of the actors' perception of key problems associated with each of these cases' activity systems in relation to their inability to successfully implement and internalize the management practices, as it relates to their respective commercialization efforts. Similar participatory approach has been used by [14] to identify specific organizational problems related to specific tasks in Finnish hospitals and health care system.

3.2 Data Analysis Procedure

A three-way analysis approach was used. These include an object-historical analysis [10], a theory-historical analysis [10] and an actual empirical analysis [10]. In the object-historical analyses, the successive developmental phases of the activity systems of the organizations were identified and analyzed. The analytical interpretation is guided by [10] fourth principle of activity theory. In the theory-historical analyses, the set of shared secondary artifact (i.e. concepts and models) that were utilized by the organizations during their commercialization process (i.e. the developmental phases of their organizational activity systems) were examined and the formation of contradictions initiated by/or connected to the instruments used in the successive developmental period of the respective cases central activity systems were identified and analyzed. The analytical interpretations are guided by [10] third principle and fifth principle of activity theory. In the actual empirical analysis, the internalized and invented organizational practices professed and actually used or upheld by the actors within the respective organizations or cases were analyzed. The results of the historical analyses is used to understand the past activity systems of the organizations and their foreseeable activity systems (based on the management practices model). The analytical interpretation is guided by [10] second principle of activity theory.

4 Results Analysis and Discussion

The analytical approach for the four cases is underlined by the characteristic appraisal of tensions and contradictions in each single-case's organizational activity system. Pattern-matching is used to compare and contrast the single-case's as characterized by the institutional rules, division of labour and the community.

4.1 Comparative Appraisal of Cases' Institutional Rules

Appraisal of the cases' institutional rules (i.e. with respect to how they were shaped by the organization's management structures and also how they impacted on the staff members' psycho-social environment) that the guidelines provided by the best management practices (BMP) model for governance, personnel management, and organizational management were not fully utilized by the case in Ghana, and apparently not utilized by the case in Botswana. For these two cases, their attempt to utilize these practices was highlighted by conflicts and disturbances that gave rise to the emergence of contradictions in their respective collective activity systems. With respect to the case in Ghana, it was unable to fully implement and internalize these practices as a result of its management's inability to manage the contradiction that prevailed between the organization's workforce and the rules (i.e. best practice guidelines) underlying the practices of governance, organizational and personnel management. This was found to be largely due to the complex decision-making matrix that binds the organization to a supervisory body, and for which no major attempt was made to overhaul. For the case in Botswana, it was not able to utilize the practices because of the conflicts and contradictions that were associated with its attempt. The presence of contradictions in the sub-activity system of the organization's management contributed in defining the character of the sub-activity system of the staff. The inability of the organization's management to manage these contradictions was due to their failure to deal with the tensions that has accumulated both within and between their respective activity systems. Therefore, the rules that prevailed in these two cases are shaped by civil service codes which lacked the requisite flexibility to relate to the requirements of their efforts to commercialize. As such, the practices of governance in these two organizations are characterized by a bureaucratic organizational structure that remained vertical and hierarchical (based on job description) as against the best practices for organizational management which is to be based on objectives.

In contrast to these two cases (i.e. Ghana and Botswana); the cases in South Africa and Trinidad were able to shape their institutional rules in conformity with the guidelines provided by the BMP model for governance, personnel management, and organizational management. While the commercialization effort of the case in South Africa was strongly enhanced by the overhaul of its civil service structure using the specific guidelines provided in the BMP model, the effort of the case in

Trinidad was slightly hampered as a result of the partial overhaul of its civil service structure (i.e. it retained some civil service-oriented codes as a way of protecting the government's interest in the organization). Thus for the case in Trinidad, its attempt to adapt the best management practices alongside elements from its partially overhaul civil service structure resulted in conflicts and disturbances inside the organization, leading to a contradiction between the management team (as subject of activity) and the institutional rules, but which could not be dealt with. In comparison, the case in South Africa was able to utilize the guidelines provided by the best practices model for governance, personnel management, and organizational management. This was due to the ability of its management to deal with conflicts and disturbances that emerged in their (i.e. management) sub-activity system. The organization was able to identify and simultaneously deal with contradictions that emerged between the management and the community as well as between the community and the institutional rules. An example in this respect was the way it (i.e. case in South Africa) dealt with the tensions and contradictions that emerged between the sub-activity system of the management and that of the staff members, as a result of the staff members' initial opposition to the organization being transformed into a commercial entity, the organization was able to manage this contradiction by enhancing the efficiency of its communication system with an effective information flow process. This contributed to the creation of an empowering psycho-social environment in the organization and which motivated the staff members to relate positively to the organization's commercialization process. Unlike the cases in Ghana and Botswana (to a large extent), and the case in Trinidad (to some extent), the case in South Africa (through the use of a participatory approach), was able to ensure and sustain the internalization of the best practices for both organizational management (i.e. project-oriented management style which is based on objectives) and governance. From the perspectives of governance, the organization was able to put in place a legal structure that enables it to operate under both financial and decision-making autonomy. Additionally, a majority of the representatives on its board were also industry clients and the board's mandate is defined accordingly to fit the role that the organization's clients serve in the innovation chain. In the same vein, the management was responsible for identifying the needs for change with the power to address those needs. Thus the organization (i.e. South Africa) was able to sustain this system by virtue of its management's ability to simultaneously identify and deal with emerging contradictions within their sub-activity system.

4.2 Comparative Appraisal of Cases' Division of Labour

In the appraisal of the cases' division of labour, it emerged that for both the organizations in Ghana and Botswana, the changes that were to have been guided by the best management practices for both project management and business development did not occur. The division of labour in these two cases was not

properly oriented to ensure effective coordination of activities during the commercialization process. The severity of the impact created by this phenomenon appears to have weighed more on the commercialization process of the organization in Botswana than that in Ghana. For the case in Botswana, the tensed working relationship among the staff appeared to have made the different units and/or divisions of the organization dysfunctional. Collision between the old way of handling projects and the new one was clearly visible within the division of labour during the organization's commercialization process. The consequence of this was that; the synergy that was to have emerged within the organization's community did not materialize. What emerged was rather a sense of distrust among different groups and also structural tensions within the organization. This was by virtue of the organization's inability to deal with the contradiction that emerged in the sub-activity system of the staff as a result of their reluctance to adequately relate to the outlined best practices for project management and business development, both of which define the characteristics of the division of labour. Additionally, the organization was not able to manage a subsequent contradiction that emerged between the staff and the BMP model and this also resulted in the creation of further disturbance and tension between them (i.e. staff members) and other members of the organization's community. But for the case in Ghana, it is the reluctance of the senior staff (researchers) to accept change that appeared to have resulted in such a dysfunctional working relation in the organization. This is due to the contradiction that emerged between them (i.e. senior staff members) and the best management practices model, but which the organization could not deal with. Thus, as it is with the case in Botswana, collision between old ways of handling projects and the new one is clearly visible within the division of labour during the organization's commercialization process. The consequence of this was that the synergy that was to have emerged within the organization's community did not materialize. What emerged was rather a sense of distrust among different groups in the organization.

For the organizations in South Africa and Trinidad, it was evident that their division of labour was oriented to ensure effective coordination by virtue of changes that were guided by the best management practices for both project management and business development. But, unlike the case in South Africa in which there was a full acceptance to the changes associated with these practices, the same cannot be said of the organization in Trinidad in which the best practices for business development was apparently not fully accepted. Thus while there was an absolute promotion of teamwork in the handling of projects, as a result of the synergy within and between different units/divisions in the case of South Africa, what occurred in the case of Trinidad was seemingly not absolute (i.e. teamwork was evident and functional within individual units, but appears to be dysfunctional for cross-unit teams). Generally, the functionality of the division of labour within the organization in Trinidad was negatively affected by conflicts (i.e. on the handling of the business aspect of projects) between its different specialized units and a new business unit created to enhance the best practice for business development. The prevalence of this conflict also contributed to the creation of tension among the different units themselves and the consequent emergence of contradictions in the sub-activity

system of the organization's management. Since the management was not able to deal with such contradictions, it ended up constraining their (i.e. management) attempt to manage the work functions of the different units in the organization.

Regarding the case in South Africa, the organization was able to streamline its operations by encouraging adequate clarity in its operational processes in line with the guidelines enshrined in the BMP model, especially as it concerns the practices of business development and project management as well as for personnel management. The organization was able to implement these best practices and its staff members were also able to internalize them (i.e. the best practices) by virtue of the management's ability to recognize the conflicts that emerged from the competition among the different units in the organization and the subsequent contradictions they (i.e. conflicts) caused in the sub-activity system of the management. By implication, the contradictions that emerged between the organization's management (i.e. as subject of activity) and the division of labour, on the one hand, and between the organizations's staff (i.e. community) and the division of labour, on the other, were identified and subsequently dealt with by the management. Thus, unlike the cases in Ghana and Botswana (to a larger extent) and the case in Trinidad (to a lesser extent) in which the working relationships among different units were highlighted by tensions, the case in South Africa rather showed the existence of a healthy working relationship among different units with a common platform for the various managers to network. Thus the division of labour during the commercialization process of the case in South Africa entailed signs of trust and mutual respect as well as high degree of positive collaboration and cooperation among the members of the various units and divisions within the organization.

4.3 Comparative Appraisal of Cases' Community Characteristics

Based on the appraisal of the community characteristics in the respective organizations, it emerged that the changes necessitated by the best practices for governance, capability building and project management did not materialize in the organizations in Ghana and Botswana, and to some extent the organization in Trinidad. For the case in Botswana, it was evidently not able to develop the required competence that is needed for the effective functioning of its human resource, as a result of the significant tension that pervaded its community (i.e. management team, staff members, and board) and the consequent contradiction that emerged between the management team (as subjects of activity) and the best management practices model, as it relates to the practices for governance, personnel management, capability building and project management.

For the cases in Ghana and Trinidad, their capabilities to perform were rather affected negatively by the low morale that pervaded their operating environment due to the non-availability of effective motivators (such as market-competitive

salary scales and formal/informal recognition events) as well as the apparent lack of improvement in their manpower base for the commercialization process. This was due to the inability of these two organizations' to deal effectively with the contradiction that emerged between their management teams and the best practice for personnel management. This is highlighted by the inability of the management team in the two organizations to provide effective motivators (such as market-competitive salary scales and formal/informal recognition events) as recommended by the best management practices for personnel management. In comparison to these cases (i.e. Botswana, Ghana and Trinidad), the case in South Africa was able to effect changes necessitated by the best practices for governance, capability building and project management. The organization (i.e. South Africa) effectively developed its human resource by upgrading the competences of its staff as well as providing them with effective motivators, such as market-competitive salary scales and both formal/informal recognition for achievements. This was a result of the organizations ability to deal with contradictions that emerged between dissenting staff members (as subjects of activity) and the income generation element (i.e. object) of its commercialization process. As a consequence, the organization was also able to manage contradictions that evolved between the management (as subjects of activity) and the dissenting staff (as members of the community). Therefore, unlike the cases in Botswana, Ghana and Trinidad, the organization in South Africa was able to adequately deal with conflicts and contradictions associated with its human resource development through a good recruitment policy and improvement in staff education, training and development in line with the best practices for capacity building and business development.

It also emerged that the cases in Ghana, Botswana and Trinidad encountered apparent breakdowns in their information flow processes and feedback mechanisms with non-regular interaction between their respective managements and staff members (i.e. there were tensions among the different categories of staff in all the three organizations). The prevalence of such tensions among different groups (i.e. the management team, the senior staff and the junior staff) in the respective communities of these three cases was enhanced by their inability to deal with contradictions that emerged between their management teams (i.e. as subjects of the activity) and the object of the commercialization processes whose realization they were spearheading. Thus in these three cases, their staff members harbored the feelings that their working environments did not provide them with the possibility to enhance their individual growths and abilities to become innovative. But unlike these three cases, the organization in South Africa had an efficient information flow process and feedback mechanism. There was also regular interaction between management and staff members as well as positive collaboration among the workforce in the organization. This was due to the organization's ability to deal with contradictions that emerged in its activity system as a result of tensions created by the staff who initially dissented to the idea of transforming the organization into a commercial entity. In this regard, communication within the organization was enhanced by putting in place facilities that allow easy and regular access to information. It is therefore obvious that for the cases in Ghana and Botswana, their

organizational norms/values were not significantly re-oriented to conform to the commercialization process. Both organizations retained their old identities as fully government-subvented entities (with a weak management system) in contrast to the new identities they were to acquire (i.e. a scientific-oriented research organization with an income generation capability). For the case in Trinidad, it was able to re-orient its norms/values to a significant degree but not enough for them (i.e. new norms/values) to be internalized by the entire staff of the organization. With respect to the organization in South Africa, it was able to change its organizational norms/values in line with its commercialization process by acquiring a new identity as a scientific-oriented research organization with a strong management system and the capability to self-generate income. But unlike the case in Trinidad, the organization's (i.e. South Africa) new values/norms were internalized by its entire staff.

4.4 Construct of Framework to Guide New Practice Implementation

The study has shown that the variability in the contradictions encountered by the organizations in Trinidad, Botswana and Ghana in relation to their best management practices model implementation and the quality of their collective activity systems, are only understandable against their own history. It is also obvious that the introduction of a new instrument from the outside by these organizations into their activity systems led to problems, ruptures, breakdowns, and clashes (but which events the management could not manage) as a result of some old elements within their activity systems, specifically, the institutional rules and division of labour, colliding with the new ones. Thus the ability of organizations (such as cases in Ghana, Botswana and Trinidad) to manage such new developments (i.e. emerging conflicts and disturbances), as it is indicative of the case in South Africa, is dependent to a large degree on the extent to which they can manage the character of their communities. This point is underscored by the variability in the achieved (as compared to the expected) outcomes of the commercialization processes of the four cases which is (i.e. the variability) also underlined by the degree to which the cases were able to manage the conflicts and disturbances that emerged in their organizational activity systems. In this respect therefore, it is argued that in the application of the best management practices model (i.e. as instrument of change) by the four cases, the orientation of the elements (especially, the institutional rules, the community and the division of labour) in their collective activity systems contributed significantly in shaping the respective outcomes of their commercialization processes. Base on these findings, a framework for an efficient organizational structure with the ability to withstand any effect from its prevailing external environment could be conceptualized as having synergy among its organizational process and structure as well as its technology and personnel subsystems. Judging from the inferences drawn by [8–10] to the fact that concepts are formed by comparing

particular objects with one another and finding their common features, it is deduced that an activity within an organization must be understood not as one activity with its peculiarities, but as a real aggregate of several activities realizing the organizations life activity, as a aggregate of relations arising between these activities around the process of the organization's production system. Based on this perspective, the organizational-activity framework shown in Fig. 1 below can be used to guide the design of an efficient management and effective work organisations towards effective practice implementation in an organization.

The framework is perceived to encompass the outcome features of an efficient organizational structure for the organizational activity system of Research-oriented organizations. It highlights the harmonious relation that must exist between the indices of the best management practices (BMP) which is "instrument" being implemented and the characteristics of the implementation community members, which comprises organizational members in the Research-oriented organizations and the SMEs (as external stakeholders). Similarly, the framework highlights the orientation of elements in the organizations institutional rules, which must be clearly defined and acceptable and those in the division of labour, which also need

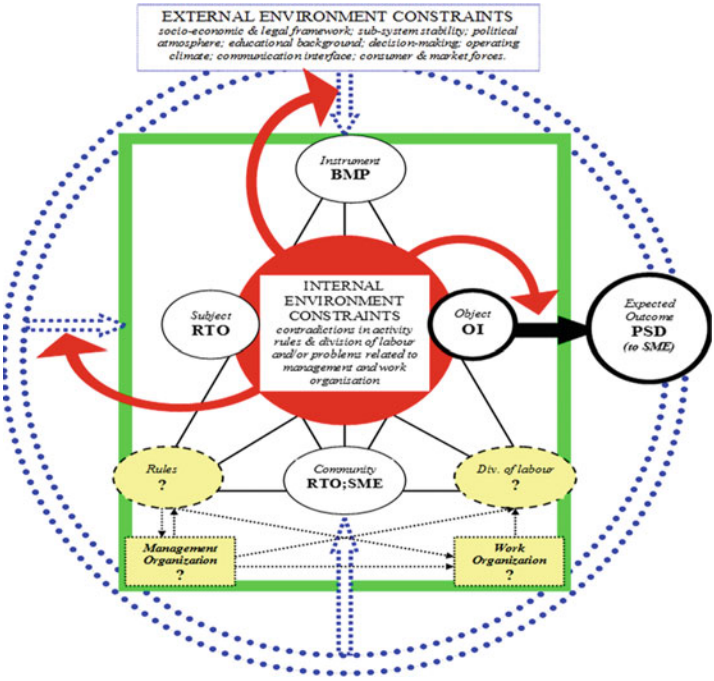


Fig. 1 Guide framework for effective design of management and work-organizing processes in new practice implementation

to be clearly outlined and coordinated. A coordinated effect of these elements can result in the attainment of the organizations' objective of efficient performances in their operations, and the expected performance outcome, in terms of effective service delivery to the SMEs. In this respect therefore, the framework can be used to guide the questioning process that could guide the appropriate design of management processes informed by the institutional rules and also the work-organizing processes informed by the division of labour underlined by the new practices (instrument) being introduced in the organizations.

5 Conclusion

It is concluded that in the process of business practices implementation, an activity in the organization must be understood not as one activity with its peculiarities, but rather as a real aggregate of several activities and relations arising from the interacting components of the organization.

References

1. Mengu, M., Grier, D.: Best Practices for the Management of Research and Technology Organizations—Special Report. World Association of Industrial and Technological Research Organizations. WAITRO, DTI, Denmark (1999)
2. Sanda, M.A.: Combined Micro-Ergonomics, Macroergonomics and Systems Study of the Application and Internalization of WAITRO-Developed Best Management Practices by Research and Technology Organizations. Department of Human Work Sciences, LTU, Luleå, Sweden (2003)
3. Hendrick, H.W., Kleiner, B.M.: Macroergonomics: An Introduction to Work System Design. HFES, Santa Monica (2001)
4. Robbins, S.R.: Organizational Theory: The Structure and Design of Organizations. Prentice-Hall, Englewood Cliffs, NJ (1983)
5. Thompson, J.D.: Organizations in Action. McGraw-Hill, New York (1967)
6. Shahnavaz, H.: Macroergonomic considerations in technology transfer. In: Hendrick, H.W., Kleiner, B.M. (eds.) Macroergonomics: Theory, Methods and Applications. Lawrence Erlbaum Associates, Publishers, Mahwah, NJ (2002)
7. Shahnavaz, H.: Cultural differences. In: Encyclopedia of Occupational Health and Safety (4th edn.). International Labour office, Geneva (1998)
8. Engeström, Y.: Managing as Argumentative History-Making. Weatherhead School of Management, Case Western Reserve University. Cleveland, Ohio. http://design.cwru.edu/index.html (2002)
9. Engeström, Y.: Learning by Expanding: An Activity-Theoretical Approach to Developmental Research. Orienta-Konsultit, Helsinki (1987)
10. Engeström, Y.: Activity theory as a framework for analyzing and redesigning work. Ergonomics **43**(7), 960–974 (2000)
11. Sanda, M.A.: Four Case Studies on the Commercialization of Government R&D Agencies: An Organizational Activity Theoretical Approach. Luleå University of Technology Press, Luleå, Sweden (2006)

12. Skoglind-Öhman, I., Shahnavaz, H.: Assessment of future workshop's usefulness as an ergonomics tool. Int. J. Occup. Saf. Ergon. **10**(2), 119–128 (2004)
13. Jungk, R., Mullert, N.: Future Workshops: How to create Desirable Futures. Institute for Social Inventions, London (1987)
14. Engeström, Y.: Expansive learning at work: toward an activity theoretical reconceptualization. J. Educ. Work **14**(1), 133–156 (2001)

Degree of Agility with an Ontology Based Application

Markku Salo, Evangelos Markopoulos, Hannu Vanharanta and Jussi Ilari Kantola

Abstract Agility is a concept and practice with significant importance in managing projects and organizations, although it can also be very risky due to its degree of fuzziness if not properly defined. This research re-defines agility, emphasizes the need for ontologies for its management, and creates an application to measure the degree of agility inside an organization. In this research, various definitions of agility were gathered for the creation of ontology through a mind map revealing the characteristics of agility. As part of the Co-Evolute theory and methodology, the first agility ontology was developed as well as an application that evaluates the degree of agility in an organization. The application includes statements on which the respondents give opinions concerning the current and future desired states of agility and its importance in an evaluative way. The application has proven to operate well and extensive validation and verification of the tests runs will follow.

Keywords Ontology · Agility · Software engineering · Fuzzy logic · Strategic management · Management

M. Salo (✉) · E. Markopoulos · J.I. Kantola
Department of Production, University of Vaasa (UVA), FI 65101 Vaasa, Finland
e-mail: mkusalo@gmail.com

E. Markopoulos
e-mail: epm@empross.com

J.I. Kantola
e-mail: Jussi.Kantola@uva.fi

H. Vanharanta
Industrial Management, Tampere University of Technology (TUT),
Pohjoisranta 11 A, P.O. Box 300, FI 28101 Pori, Finland
e-mail: hannu.vanharanta@tut.fi

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1 Introduction

When thinking and speaking about agility, one has to be cautious. Many believe that agility is a trendy concept, a tool for all cases, an easy way out that can be implemented anytime, anywhere, but that might not actually be appropriate.

The concept of responsiveness seems to be the most important characteristic of agility. Organizations are trying to be more flexible and dynamic in the face of our changing world. On the other hand, companies are looking closely at added value concepts so that they can really see that they are continuously serving their customers. Agility can also be described with other adjectives like 'adaptability,' 'customer-compliant,' 'flexible,' 'responsive,' and even 'yielding.' For agility to be conceived properly it is important to understand that the world and business, any business, is agile in many ways and that all the people inside the organization understand these different dimensions of agility in practice. Managers in particular, who are called upon to apply agility, must understand that agility starts from people and ends with innovative new management practices, solutions, products, and services for the organization and their customers. However, in some cases, making changes too quickly towards obtaining agility in management and leadership may be too risky.

To reduce the misconception of the term agility, it is important to re-define it using an ontology that can cover the areas and limits of the term in a specific environment. Ontology originally derives from philosophy and refers to the science of being. Recently, the term ontology has also been used in information technology, where it is a specification of a conceptualization. For this case study, we have created an ontology application and tested with student test subjects how organizations understand agility in companies. This paper views agility primarily from the ontology point of view for its utilization and application in business and teaching approaches, methods, and practices.

2 Defining Agility

The term agility has become very popular and trendy over the last two decades in almost all types of business and engineering activities, operations, and strategies. What is interesting is the fact that today's meaning of agility differs significantly from the dictionary definitions and the ones used prior to its adoption by the software engineering industry.

By definition agility means "being gently rolling, light, flexible, witty and nimble. It can be contrasted to rigidity." In practice, the term has a totally different meaning, as it stands for flexibility and adjustability. The agile concept became popular through the software engineering discipline and communities, as a solution to bypass bureaucratic complexity in the software development efforts imposed by strict software development processes, tools, and structures [1].

The problem that agility aimed to solve was quite clear but slightly contradictory. On the one hand, software development needed structured methodologies and a process to assure the engineering quality of the software produced, but on the other hand, technology constraints (continuously changing), client constraints (unstable requirements), project constraints (schedule and budget limitations) were considered obstacles in developing software within budget, on time, and with quality [2]. The challenge was to bypass bureaucracy in software development processes and standards without being accused of development anarchy. To solve this challenge, the agile concept was invented, or reinvented to be more precise. The logic behind agile software development is to adjust the software development best practices based on the project constraints, environment, goals, and objectives. Thus, software development on small-sized projects could avoid, for example, long design, testing, and documentation processes. On large projects, the processes could be adjusted accordingly. On critical projects, the processes could be strengthened with additional ones in order to reach the critical requirements and conditions. The methodology was that there is no methodology, only adjustability and flexibility on the methodology towards reaching the desired project goal [3]. Therefore, agility became the Lego-type adjustment of the software development process. The results of applying agility in software development were very successful and all parties involved were satisfied, as software was developed with less process overhead for the engineers and much faster for the clients.

Agility, however, is very difficult to design and very risky to apply. Reducing the number of processes from a methodology requires high capability and maturity from those who attempt to select which processes are needed, which are to be removed, and which are to be changed in order to achieve agility. The same applies in management, as acting outside the box to bypass a problem requires significant expertise in order to make the right moves [4].

In software engineering, many agile methodologies have been developed over the last two decades, some of which were successful and others less successful [5]. The Ariadne Methodology, by EMPROSS Strategic IT Consultants, is one of the first agile software engineering and project management methodologies [6]. It was developed based on the agile Lego 'build it yourself' concept according to project constraints. The ARIADNE set of processes has made the methodology compatible with 108 international project management and engineering methodologies, while it supports more than 15 different software development types such as waterfall, spiral, incremental, rapid prototyping, etc. [7] (See Fig. 1).

Agile processes are not for everyone to follow and for only the best to design. They provide significant flexibility that can be critical when needed, but require tremendous expertise and discipline in the area in which they are being practiced. Agility can be a blessing but also a curse unless its consequences are deeply understood.

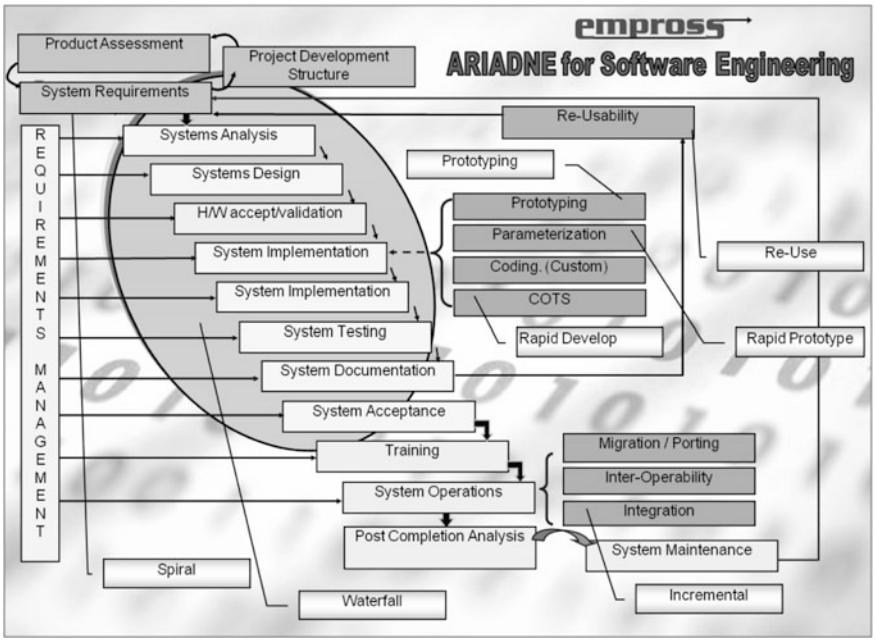


Fig. 1 Methodological approaches supported by the ARIADNE agile software engineering methodology

3 Defining Ontology

Ontology derives from the Hellenic 'on' (ón), genitive 'ontos' (óντος): "of being," neuter participle of 'eine' (είναι): "to be," and 'logia' (λογία): science, study, theory.

Based on the above definition of the term 'ontology,' it is obvious that ontologies are live and not static entities. They contain elements that have identities that affect and are affected by the environment they are used for and from [8].

The Stanford Encyclopedia of Philosophy [9] divides ontology into two different categories: firstly, ontology is the study of what there is, and secondly, it is the study of what is involved in settling questions about what there is in general. In the first case, we may ask if there is a God or not. According to Effingham [10], ontologists split things into two categories, i.e. the abstract and the concrete. Osterwalder [11] has studied business model ontologies and has developed practical ontologies through a theoretical approach. However, his approach is derived from an ICT approach; which also shows that ontologies in practical life are mostly used in information technology, business process modeling, and related activities.

Dietz [12] has studied enterprise ontology from his ICT background and point of view. In his mind, there has to be a conceptual model that is coherent, comprehensive, consistent, and concise. This model is an ontological model. He takes the

example of the World Wide Web, which serves to provide a common basis for common understanding on some area of interest among a community of people. Vanharanta and Kantola [13] have taken some steps towards more practical approaches in ontology, although in many of their approaches there is an application in the background.

4 Agility in Creating Ontologies

Even though agility in ontologies can be considered their natural behavior, it is often hard to see this dimension when using them and much more when creating them. To enable agility in the creation of ontologies, one must understand the relationship of the elements that compose an ontology. All ontologies have passive and active elements that define a microcosm of activities, operations, and goals. This microcosm affects and is affected by other ontologies, based on the way they interact. Therefore well-designed ontologies are those that can be used the best and the most, meaning that they must be agile in order to achieve the desired flexibility and adjustability.

Furthermore, the elements in an ontology can also be characterized as the imports and exports of information in the ontology. They are the elements that collect the information to be processed in the ontology and the elements that export information after being processed in the ontology. Figure 2 presents the elements of an agile ontology.

The challenge in the creation of agile ontologies can be seen as a double one. First, it is important to properly identify the ontology elements and their relationships in order for the ontology to be agile, i.e., to be used with flexibility and adjustability on the maximum number of occasions. The second challenge is not actually based on the ontology itself but for the designer of the ontology to use it properly in the design of processes, systems, methods, and practices. Having a great tool does not make it great unless it is also used well. Besides the proper definition of the identities of the ontology elements towards achieving agility, the taxonomy

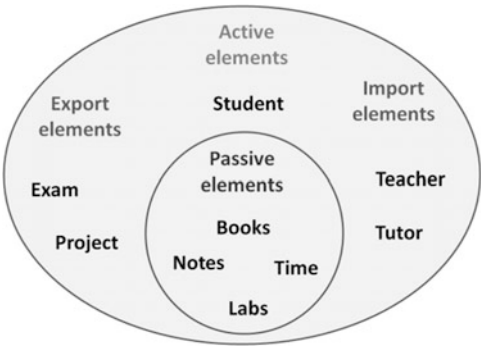


Fig. 2 Agile 'Teach' ontology with relationships between elements

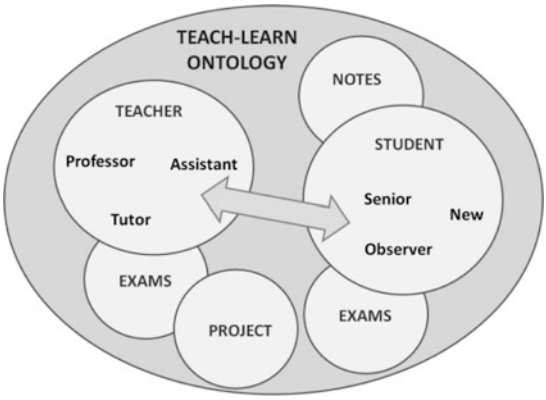


Fig. 3 Taxonomies within ontologies for maximum ontology agility

of the elements also has a great significance for agility. An ontology can be designed to include sub-ontologies, which are actual taxonomies of the ontology elements. This breakdown of the ontology elements into taxonomies can define the range of usage of the ontology and greatly affect its behavioral identities.

The ontology 'teach' and the ontology 'learn' for example seem to have a direct link and meaning, but agility is achieved in the ways teaching is done and the ways learning is achieved. The degree of agility is based on the number of ways that such combinations can be satisfied. One way to achieve this is if the two ontologies can be viewed as taxonomies of a greater 'Teach-Learn' ontology that defines variations of teaching and learning within the ontology (Fig. 3). These variations define agility in the terms in the use of the ontology.

Agility is not a practice, a method, a process, or a trend, but an art of understanding real work and trying to satisfy its continuous changing needs. Agile ontologies are very important towards developing agile processes, methods, and practices. The agility resides in the ontology and not in the methodology, which is composed of ontologies that drive and support the process and practices of the methodology. Once such a view can be conceived, then obtaining agility can be very easy, but it is not easy to think easy.

5 Ontology Application

An ontology application exists on the Evolute platform [14]. The platform has various other applications to assess and follow up the development of an organization within its various operations and functions. The test application is called Catenary.

The Evolute approach follows a modular process involving individuals and stakeholders, where their perception and understanding of organizational resources are sought and collected with the help of statements, one by one. The Evolute system [14, 15] is a platform that computes and visualizes the meaning of the knowledge input collected from stakeholders. The computing in the Evolute system

is based on soft-computing methods and algorithms in order to cope with the imprecision and uncertainty embedded in natural language and human knowledge inputs. Management uses the computed current and future meaning of organizational resources to make a development analysis of the organization. The analysis can be made of the whole group and sub-groups. Stakeholders can be involved in this management step, according to the modular process.

6 Research Study

A research study was conducted in January–February 2016 with 19 persons, representing both Tampere University of Technology Pori unit students and various Finnish companies. The researchers created ontology statements that were entered into the application. The number of statements was about 110, varying from the

Table 1 Example of agility ontology statements

High level concept	Sub-concept	Indicators	Min	Max
General concept	Agility awareness	– I understand the term agility	not at all	completely
		– Most people in our organization understand the term agility	not at all	completely
		– Our organization has to be agile	not at all	definitely
		– We have no need for agility in our organization	not at all	definitely
		– Our company is “fast”	not at all	absolutely
		– We understand our company strategy	not at all	completely
		– I understand our company strategy	not at all	completely
	Agility suitability	– Agility is suitable for our organization	not at all	definitely
		– We know how to utilize agility in our organization	not at all	absolutely
		– Agility has helped our organization	not at all	totally
		– We have to plan our things better	not at all	absolutely
		– Our organization’s innovativeness is at a high level	not at all	definitely
		– We have an organization culture that encourages innovations	not at all	completely
	Innovate	– Our organization’s innovativeness is at a high level	not at all	definitely
		– We have an organization culture that encourages innovations	not at all	completely
		– We have facilities that promote innovations	not at all	completely
		– We have daily meetings where we can share our innovative ideas	never	always

understanding of the term agility to its implementation and control. There were several sub-categories as well.

Since this was just the first test of the application, the number of participants was limited. Hence it is difficult to draw final scientific conclusions from this study alone. More research is required to validate and verify the results of this kind of study. An example of how the statements are organized is shown in Table 1.

7 Results

The Catenary application itself worked perfectly as expected. The results reflect the status of the respondents' organizations and are taken as such. Each organization has to continue its internal thinking and development based on the achieved results. They show, slightly surprisingly, that the investigation of problems category is in the best state within the organizations, whilst the rest are more or less at the same level, with general principles and rules being slightly higher than tools and general concept. The aggregate results can be seen in Fig. 4 and detailed results by topic in Fig. 5, while Fig. 4 shows the summary by category.

In Fig. 5 the individual statements have been sorted by their "ranking."

The current state seems to be best in delivery management, performance, and benchmarking. The opposite is true for instance for TPM, 5S, innovativeness, etc. One cannot say whether the results are right or wrong but they show a direction for the company to develop its activities. In Fig. 6 the individual statements have been sorted by their "ranking" according to the future state.

The most important point in Fig. 6 is to share knowledge. It is also possible to obtain an index from the system describing the ratio of the future to current state. This index is called the Evolute index. From the data we can get the following Fig. 7 where the Evolute index test results are shown.

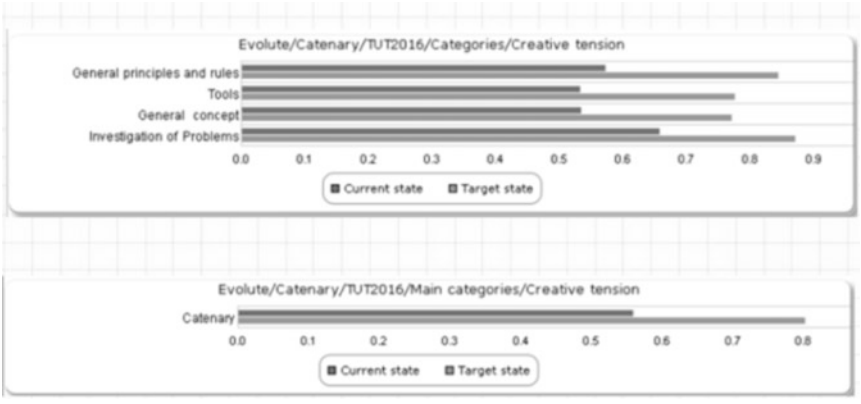


Fig. 4 Summary of agility study results by main category

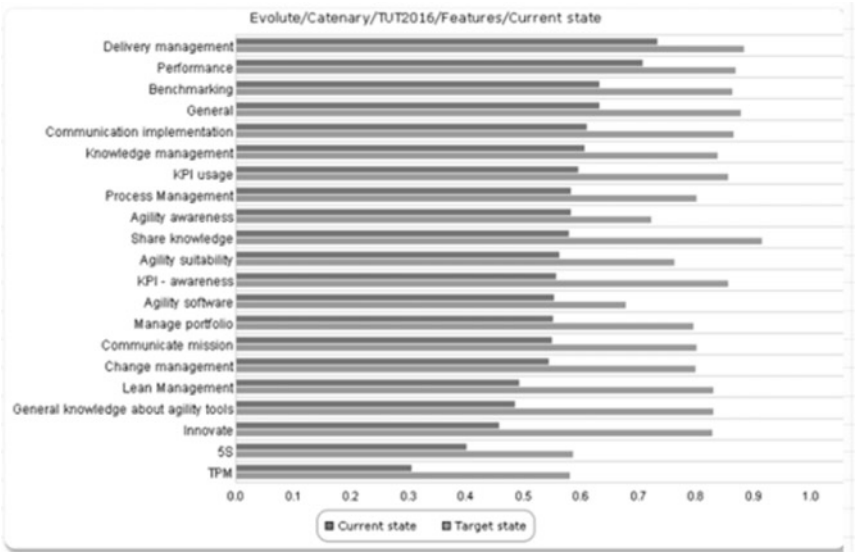


Fig. 5 Details of agility study results by topic

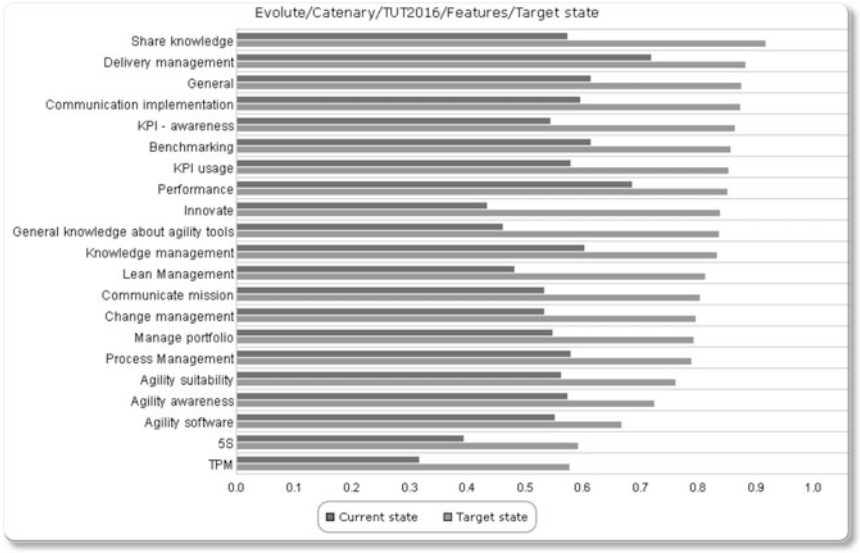


Fig. 6 Test results sorted by future state

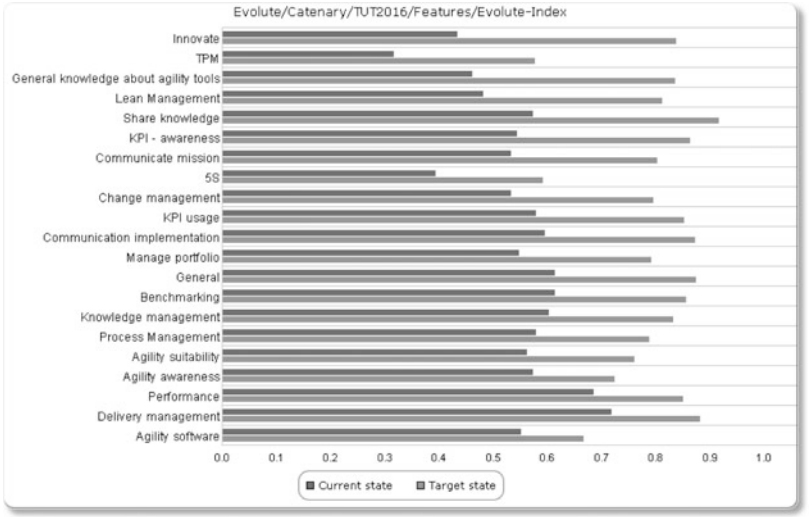


Fig. 7 Test results with the Evolute index

From the results we can see that the highest index is in innovation issues, followed by TPM, and after that general knowledge about agility tools. In this index, the lowest concepts are agility software and delivery management.

The statements in the application should be further developed. However, in this application, in contrast for instance to the applications that are closer to psychological tests, it is fair to say that there is no need to compare the results with similar applications. On the other hand, we do not know of any similar practical agility application currently available on the market.

8 Discussion and Conclusions

Ontology is not very common in business, apart from applications for the information and communications technology sector, which invented the concept. Even to understand what ontology means is very difficult for most people as it integrates a philosophical dimension. Philosophy is a difficult subject and most business people understand very little of it. Hence easy methods need to be created and taught to give the necessary help for understanding such concepts. Tools that have been developed by EMPROSS or Evolute LLC support this thinking in the agility area.

The agility created in the plans and strategies of many businesses obliges managers to be very careful when implementing it. Agility can suit some businesses, but not necessarily all of them. For instance, should governments be agile or not? How about many heavy industries—can they be agile? and to what degree? In our opinion, agility is well suited for the software business, and electronics-related

businesses like mobile phones, electronic components, computers, etc. where innovation cannot be controlled with a static structure and non-flexible management and leadership.

The agility/ontology tool developed during this research is very practical and can be used in any organization. It clearly shows the status of agility in an organization and its development needs. We can find many similar areas, functions, and disciplines in organizations to develop ontologies. Developing an ontology by using the application is not a very complicated task and can be used by everyone. To achieve the effective development of such applications, a minimum set of research statements is required. There are nowadays so many questionnaires that many organizations and individuals have to participate in that there is a common dissatisfaction towards large questionnaires and repeated processes.

Time will show whether ontologies will be used more in practical business life. One can assume that they will be used more and more when developing information systems and business processes for managing innovation effectively, but we have to think more broadly, as innovation does not only exist in the technology sector. Ontologies can help this thinking, as they provide all the potential needed to support agile thinking in organizations with processes and tools.

References

1. Beck, K., et al.: Manifesto for agile software development. Agile alliance. Retrieved 14 June 2010. Available at http://agilemanifesto.org/ (2001). Accessed 14 Dec 2015
2. Markopoulos, E., Panayiotopoulos, J.-C.: A project management methodology selection approach based on practical project and organizational constraints. WSEAS Trans. Comput. Issue **8**(4), 934–942 (2008)
3. Markopoulos, E., Bilbao, J.L., Stoilov, T., Vos T., Reschwamm, K.: Project management stage mutations within agile methodological framework process transformations. In: WSEAS'05 International CSCC Conference, 12–16 April. Beijing, China (2008)
4. Markopoulos, E.: ICT process development and evolution models and the first financial Bank of Montenegro case. Bankar—Montenegro Bank Assoc. J. **1**(1) (2008)
5. Markopoulos, E., Bilbao J.L.: An evaluation, correlation and consolidation of information technology project management processes. In: 1st International Conference on Engineering and Mathematics. Bilbao, Spain, July (2006)
6. EMPROSS.: The ariadne methodology. Available at http://www.empross.com/en/the_ARIADNE_Methodology (2002). Accessed 14 Dec 2015
7. EMPROSS.: The ariadne methodology. Available at: http://www.empross.com/en/methodological_approaches (2002). Accessed 14 Dec 2015
8. Oberle, D., Guarino, N., Staab, S.: What is an ontology?. In: Handbook on Ontologies, International Handbooks 1 on Information Systems. Springer, Heidelberg (2009)
9. http://plato.stanford.edu/index.html March (2016)
10. Effingham, N.: An Introduction to Ontology. Polity Press, Malden, MA, USA (2013)
11. Osterwalder, A.: The Business Model Ontology—A Proposition in a Design Science Approach. l'Ecole des Hautes Etudes Commerciales de l'Universite de Lausanne, Switzerland (2004)
12. Dietz, J.L.G.: Enterprise Ontology. Springer-Verlag, Berlin (2006)

13. Vanharanta, H., Kantola, J.: Strategy needs structure: structure needs ontologies—dynamic ontologies carry meanings. In: Liu K., Filipe J. (eds.) Proceedings of the International Conference on Knowledge Management and Information Sharing, 4–7 Oct 2012, pp. 261–264, Barcelona, Spain. SCITEPRESS—Science and Technology Publications, Portugal
14. https://www.evolute.com March (2016)
15. Kantola, J.: Organizational Resource Management: Theories, Methodologies, and Applications, 138 p. CRC Press (11/2015)

Taking Tacit Knowledge Seriously in Strategy-as-Practice

Dinesh Poudel

Abstract This conceptual paper uses strategy-as-practice as a theoretical background and argues the significance of tacit knowledge during strategy work. The fundamental concept and past research approaches in the field of strategy-as-practice is presented to link how individual and collective tacit knowledge intersect in strategy-as-practice field. This paper emphasizes the need of studying tacit knowledge from strategy-as-practice perspective and ultimately provides avenue for future research, by so doing, this focus of study contribute to enlarge the theoretical as well as empirical contribution to the field of strategic management and organizational studies.

Keywords Strategy-as-practice · Tacit knowledge · Organizational actor

1 Introduction

Organizational actors[1] are all surrounded and held by knowledge. Most of the actions an actor takes in practice are outcome of his/her knowledge. Intrinsically, an actor and knowledge are inseparable. In an organizational context, actors within an organization must possess knowledge and exchange with other organizational members so to accomplish organizational objectives. For instance, if a manager assigns a task to an employee, transfers of knowledge likely to happen. Similarly, to perform the assigned task, the employee must have possessed required knowledge. Therefore, knowledge is an integral part of people because ninety nine percent of works done by people are based on knowledge [1]. With this rationale, it is certain that the amount of knowledge an actor(s) need to function everyday activity in an

[1]An actor in an organization refers to an individual who performs organizational task. By saying actor this paper refers to an employee, a practitioner, a manager, an individual and people in an organization et. cetera.

D. Poudel (✉)
University of Vaasa, P.O. Box 700, 651010 Vaasa, Finland
e-mail: dinesh.poudel@student.uwasa.fi

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organization is immense. For instance, Grant [2] highlights knowledge being the most critical asset for a company. However, acquiring knowledge is not enough for organization to sustain due to increasing competition between organizations. Therefore, this competition demands organizations to acquire sustainable competitive advantage. The well said line from Nonaka and Takeuchi [3] becomes important to quote here "in an economy where the only certain is uncertainty, the one sure source of lasting competitive advantage is knowledge". Therefore, in this knowledge age, an organization is the one that learns, remembers, and acts based on best available information, knowledge and know-how [4]. Having said that, what is most important for organizations is to gain sustainable competitive advantage, therefore, sustainable competitive advantage, according to Barney [5], can only be achieved through organizational resources, through exploitation of valuable, rare, inimitable, and non-substitutable (VRIN) nature of resources of an organization. Hence, knowledge as an organizational resource is notably important and new research should keep on scratching the organizational knowledge, and most importantly, VRIN nature of knowledge to gain sustainable competitive advantage. Admitting the knowledge as an organizational resource, actors disseminating and dealing with knowledge should not be separated because the competitive advantage can be achieved and sustained through the interactive behaviors of people [5]. When people interact in an organization there is an exchange of knowledge. However, some knowledge is easier to exchange (explicit knowledge) while other is more complex (tacit knowledge). The most popular research concern sheds light on tacit knowledge (TK). For instance, some studies have argued that TK plays a central role in the development of sustainable competitive advantage [6–8]. Hence, TK should be delved further and researchers should seriously aim at finding methods to exchange and share TK between actors in an organization.

2 Aim of the Paper

This paper seeks to conceptualize an understanding of TK in 'strategy work'.[2] To achieve this understanding, this paper attempts to highlight 'strategy-as-practice' (SAP) field of study as a theoretical background which looks closely into actors' everyday life in an organization, what they do in practice, and how they practice strategy work. In so doing, we can acquaint the significance and relationship of TK in SAP field of study. It is, however, becomes crucial to note that this study spotlight specifically 'TK'. Firstly, because, TK is considered as a source of competitive advantage and is complex in nature which demands more studies over

[2]Strategy work ("strategizing") includes actions, interactions and negotiations of multiple actors and the situated practices that they carry out in accomplishing an activity [10].

explicit knowledge (EK). Secondly, limiting the focus allows this paper to present important side of knowledge as a subject of study that SAP field should delve down deeper in order to gain sustainable competitive advantage.

3 Theoretical Background

This theoretical section draws upon two wide theoretical frames: (1) SAP, and (2) knowledge (emphasizing TK). The former theoretical frame underpins social theory followed by the thematic direction in SAP field, whereas the latter theoretical frame presents epistemological and ontological dimension of knowledge, and the type of knowledge. The two aforementioned frames are then linked to draw our attention on the research gap which this paper aims to appraise.

3.1 Strategy-as-Practice (SAP)

The major contrast between the traditional theories of strategy and SAP is that, this fairly new perspective emphasize in 'people' who do strategy, and focus their activity. Therefore, SAP is also called an activity-based view [9]. This activity based view argues that strategy is situated and accomplished socially which arise from actions and interactions of multiple level actors [10]. Previous research work in SAP field of study has grown our understanding of internal life of an organization and highlights three key elements that encapsulate the SAP approach: (1) *Practitioners*: those people who do the strategy work; (2) *Practices*: the social symbolic and material tool through which strategy work is done; and (3) *Praxis*: the flow of activity in which strategy is accomplished [9–11]. These three element combined together contribute to organizational strategy. Therefore strategizing happens only at the interface of aforementioned three elements (see Fig. 1).

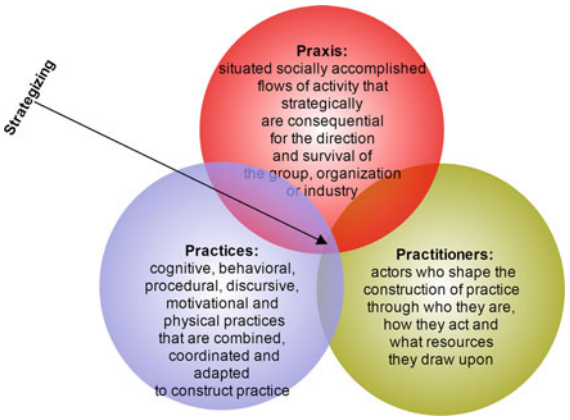


Fig. 1 The nexus between praxis, practices and practitioners [9]

3.2 Theoretical Direction of SAP

The theoretical focus of SAP field seems to stress, predominantly, at the micro level. Most specifically, according to Johnson et al. [11], four main approaches were recognized which are premeditated to link SAP with TK later in upcoming chapter (see also Fig. 2): (1) *situated learning approach*: this approach argues that the learning emerges through activity of those actors involved in learning process. Therefore, knowledge is not static, rather evolves dynamically through activities; (2) *the sense making and organizational routines*: sense making is a process through which actors work to understand the organizational actions and make sense of them. It is a social activity where individual share, retain, and preserve the plausible stories [12, 13]. On the other hand, organizational routines are the repetitive actions those actors within organization practice; (3) *institutionalist theories*: formal organization is a system of coordinated and controlled activities and this includes the work embedded with technical relations and boundary-spanning exchange. With that said, institution theory emphasizes how formal organization should be through the rule and cultural norms [14] and; (4) *actor-network theory*: this approach treats objects as a part of social networks. Furthermore, actors in an organization are not just people, but they include things that are used by them, or perhaps wide network of things associated with them.

In this array, our concern to find more insights about organizational actors who are embedded with wide network, their situated learning process, their sense making mechanism and routines they practice within institutional context certainly matures our rationale to seek new dimensions of study in the field of SAP. Some of the study, as of now, stands significant to mention here, for instance, some paper focused on organizational processes [15, 16], people [17], the way people interact to make sense of strategy [18], discourse, seeing managers' talk as practice and strategy as created through talks [19], the tools people use in strategy work [20]. These approaches may emphasize different themes, however, the center idea of aforementioned perspectives seems to widely emphasize people working socially, with other actors, dependent on different kinds of tools, and their activities depends both on mastery of details within their organization and their wider connection to outside world [11].

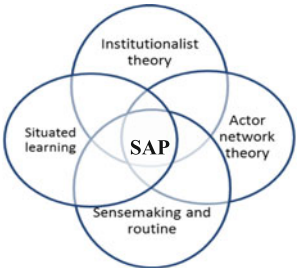


Fig. 2 The four theoretical approaches and SAP

3.3 Knowledge

Actors' knowledge and the sharing of that knowledge between actors during interaction in an organization should not be neglected as knowledge has been widely regarded as the important resource of firms [21–23]. According to Nonaka [24], knowledge could be explicit or tacit. Therefore, understanding the distinction between tacit and explicit knowledge becomes imperative. Most importantly, the implication of this distinction allows organization to seize knowledge, share within employees through practice, and ultimately gain competitive advantage over other competitors. Different organization possess different types of knowledge, specifically, at micro level, knowledge within individual-to-individual differs widely. Some knowledge is shared whereas some are kept within an individual. Perhaps, from SAP point of view, knowledge that cannot be shared or transferred, certainly, hinders the strategy work. An important line from Blackler [25] seems coherent to mention at this point "rather than regarding knowledge as something that people have, it is suggested that knowing is better regarded as something that they do". I shall justify the argument in upcoming chapter where linkage of knowledge and SAP work will be shown.

3.4 Epistemological Dimension: Tacit and Explicit Knowledge

Michael Polanyi, a well-known chemist and philosopher, claims "we can know more than we can tell". This claim refers the nature of TK being complex to articulate therefore it should rather be experienced. TK resides inside our head and is contextual. Knowledge viewed by one may vary from the other as it tends to be subjective in nature. On the contrary, explicit knowledge is easier to articulate and can be transformed to tangible form. We all possess and use both tacit and explicit knowledge in our daily life; however, a large part of human knowledge is tacit [26]. From organizational point of view, we seek to rather harness our TK since the importance of TK in firms' competitiveness has been widely recognized and studied by several authors [27–30].

3.5 Ontological Dimension: Individual and Collective Knowledge

It was proposed by Nonaka and Konno [31, 32] that knowledge is created by members in an organization through collective and personal knowledge conversion process. In this way knowledge conversion process transforms explicit to tacit and vice versa, and also, collective to individual knowledge and vice versa. However,

knowledge in an organization resides at the individual level. On the other hand, collective knowledge is the distributed form of knowledge in an organization that is accumulated and stored in organizational rules, procedures, routines and shared norms. This comes from the interaction of people within an organization as it is called 'collective mind' of the organization [33].

3.6 Types of Knowledge

According to Blackler [25] based on original taxonomy suggested by Collins [34] five knowledge types are identified (also see Table 1): (1) *Embrained* (*individual-explicit*): embrained knowledge includes individual cognitive and conceptual skills and abilities determined by the 'personal setup' of the brain [34], for instance, skills and abilities that are acquired through formal education; (2) *Embodied* (*individual tacit*): embodied knowledge includes an ability to apply knowledge in a given situation. For instance, routines, habits, tasks and information we understand without thought; (3) *Encultured*: according to Collins [34] encultured knowledge, could not exist without the existence of social group, this cannot be written and learnt from written forms and cannot be expressed by rules. It is a process of acquiring shared understanding and this is heavily dependent on language; (4) *Embedded* (*collective-tacit*): embedded knowledge resides in systematic routines [25]; and (5) *Encoded* (*collective-explicit*): encoded knowledge includes completely explicit knowledge which can be conveyed through symbols, signs, books, codes [25].

As shown in Table 1, this paper specifically concerns and shed light into TK (see study focus in Table 1), firstly, because it is a source of competitive advantage. Secondly, sharing of EK is easier and perhaps we have good understanding of EK and methodologies for the research, however, sharing TK is laborious, and perhaps some of them are never shared. The research in this field assuredly needs theoretical linkage and methodological understanding to study TK. This hints us to seek ways to harness the TK and deepen an understanding from SAP perspective. For this reason, this paper focus TK as a central subject to conceptualize by pinpointing both individual TK (embodied) and collective TK (embedded and encultured).

Table 1 Type of knowledge and its dimensions

		Ontological dimension	
		Individual	**Collective**
Epistemological dimension	**Explicit**	Embrained Knowledge	Encoded Knowledge
Study focus	**Tacit**	Embodied Knowledge	Embedded Knowledge &Encultured Knowledge

4 Intersection of SAP and Knowledge

Since SAP argues the interaction of organizational actors being important in strategizing, this is when practitioners, practices, and praxis interface. For this, we will use symbol A, B, and C to explain how each element (praxis, practices, or practitioners) when interact with the other requires knowledge i.e. in this paper TK as the focus of study. In so doing, future research in SAP and TK can be positioned at A, B, or C area (see also Fig. 3).

4.1 Practitioner, Practices and Tacit Knowledge (A)

In an organization, practitioners are the workers of strategy work, whereas practices refer to the shared routines of behaviors, their activities to perform any given task including traditions, norms, and process of using things in an organization. This tendency by all means involves the knowledge as a bridge between practitioner and the kind of practices they do. Knowledge in this scenario comes in different shapes and sizes-individually or collectively EK-to-individually or collectively TK. One of the main concerns of this study is to argue the presence of knowledge between these two elements of SAP (practices-practitioners). Most importantly, by studying tacit nature (embodied, embedded, encultured) of knowledge in this interface largely contributes to both SAP field to enlarge our understanding of practice perspectives of strategy (Fig. 4).

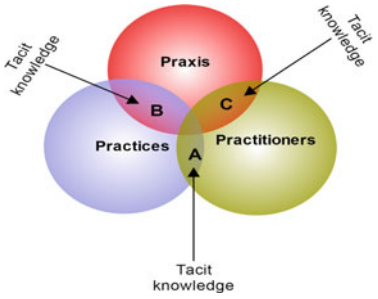


Fig. 3 Intersection of praxis, practices, practitioner and tacit knowledge



Fig. 4 Intersection of practitioners, practices, and tacit knowledge

4.2 Practices, Praxis and Tacit Knowledge (B)

In an organization, praxis refers to what strategy practitioners actually do socially that strategically are consequential to execute strategy, for instance, communicating, meeting, consulting et cetera. In which practices refers cognitive, behavioral, procedural and discursive combined, coordinated and adapted to construct the practice. This tendency by all means involves the knowledge as a bridge between practices that are constructed through praxis. Knowledge in this scenario comes in different shapes and sizes-individually or collectively explicit knowledge-to-individually or collectively TK. One of the main concerns of this study is to argue the presence of knowledge between these two elements of SAP (praxis-practices). Most importantly, by studying tacit nature (embodied, embedded, encultured) of knowledge in this interface largely contributes to both SAP field to enlarge our understanding of practice perspectives of strategy (Fig. 5).

4.3 Practitioner, Praxis and Tacit Knowledge (C)

In an organization, strategy practitioners form a large part therefore play an important role. These strategy practitioners drive world's most powerful organizations forward [35], and strategy practitioners' ability in adopting different practices and deploying them in their organizational context construct an effective praxis [36]. Most importantly, by studying tacit nature (embodied, embedded, encultured) of knowledge in this interface largely contributes to both SAP field to enlarge our understanding of practice perspectives of strategy (Fig. 6).

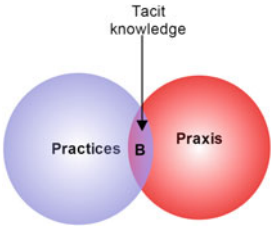


Fig. 5 Intersection of practices, praxis, and tacit knowledge

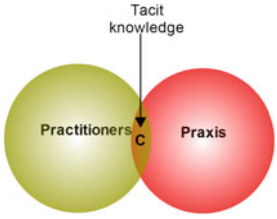


Fig. 6 Intersection of practitioners, praxis, and tacit knowledge

4.4 Actors in SAP

Strategy as practice arises from the interactions between people, lots of people—top managers, middle managers, employees, consultants, accountants, investors, regulators, consumers. While all these people might not be designated formally as 'strategists', however, their actions and interactions contribute to the strategy of an organization [17]. Therefore, a practice agenda addresses the issue of multiple actors as skilled and knowledgeable practitioners of strategy, examining how their skill is constituted in doing different aspects of work of strategy [37]. Practitioners are seen as social individuals, interacting with the social circumstances involved in doing strategy. The focus is thus upon how practitioners act, what work they do, with whom they interact, and what practical reasoning they apply in their own localized experience of strategy [38, 39]. The aim of the practice agenda is to see strategy through the eye of the practitioner.

4.5 Actors and Tacit Knowledge

Actors in an organization interact with their surroundings; they capture information, transform the captured information into knowledge, and react according to what they possess as knowledge. Actors either possess EK or TK. Without knowledge no actors perform. Similarly, an organization cannot perform without actors that possess knowledge. With this rationale, social interaction, according to SAP, that happens between actors, certainly, practice sharing of knowledge. For instance, top management team sharing the knowledge of newly crafted strategic planning to lower manager which is then shared with lower level employees. Actors can only create knowledge with the interaction that takes place within the group. And through dialogue, discussion, experience sharing, and observation, knowledge can be amplified or crystallized at the group level.

5 Intersection of Theoretical Approach of SAP and Tacit Knowledge

Four main approaches in SAP that defines strategies as presented in Sect 3.2 are linked with the TK. Furthermore, it therefore provides us the rationale of why TK should be our future agenda in SAP field of study. The head-to-head linking of aforementioned SAP approach to TK is discussed below.

5.1 Situated Learning and Tacit Knowledge

From the theoretical concept of situated learning, actors must involve to make learning possible. Hence, TK that resides in an actor must be shared by transferring tacit-to-explicit knowledge. Similarly, the accumulated collective TK from one group must also be transferred or circulated to the other within organizational actors. We can, therefore, be certain that TK is situated among actors and this must be transformed for organizational learnings.

5.2 Actor Network Theory and Tacit Knowledge

From the theoretical concept of actor network theory, actors do not function in isolation but wide network of things are associated. In this context, TK certainly lies across actors to perform organizational task. The degree of tacitness, nonetheless, depends on the nature of task to be performed. Some task may require highly TK while some fairly tacit. Actors' knowledge is associated with accumulated tacit and EK of organization.

5.3 Sense Making, Routines, and Tacit Knowledge

The interesting example presented by Nonaka and Takeuchi [3] about the success of Japanese companies explains us that everyone involved in an organization play critical role in knowledge creation. For instance, front-line employees, middle managers, and senior manager all should be involved. Frontline employees are immersed in everyday activity and perform their job where some degree of TK is involved. These frontline employees are given freedom to do it their own way, and surprisingly they are incredible to design a new concept. Although, employees create knowledge they may find it tough to communicate that knowledge to others. Learning new knowledge is not a passive act as they actively interpret and make sense of it according to their situation and perspective. Therefore, line-managers' job and their TK becomes important to direct this confusion and make sense of the organizational knowledge. Similarly, senior and middle managers accommodate the sense of direction and framework that helps employees to conceptualize and make sense of the knowledge that is created. Because an important knowledge in one context may lose meaning if not communicated in a purposeful manner. The important role of middle manager acts as a bride between top management and front-line employees aligning the sense-making process within an organization through TK.

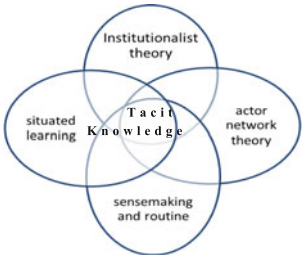


Fig. 7 Four theoretical approaches of SAP and tacit knowledge

5.4 Institution and Tacit Knowledge

From the theoretical concept of institutional theory [14], organizational activities are controlled and systemized. Similarly, knowledge creation and sharing between actors are formalized. For instance, top management team shares the knowledge to their lower employee according to the organizational rules and culture and this pose challenges to transfer them to explicit knowledge (Fig. 7).

6 Future Avenue for SAP Research Taking Tacit Knowledge Seriously

We have acknowledged methodological issues to empirically study TK due to its vagueness. TK as it is defined as something hard to articulate poses challenges to do research. One of the reasons stands out to be the 'expression' of TK—how to express what has not been expressible up until now [6] is yet a question we seek to understand. However, this paper presented links between TK and the SAP field of study to argue why studying TK from SAP perspective is beneficial. I shall explain further why this link(s) help us dig deeper to enlarge better understanding of TK and SAP field of study. Firstly, from knowledge as a field of study, the future study will attempt to understand: what type of TK is required in A, B, and C position to perform any strategy work; what is the role of TK at strategy work. Secondly, from SAP field of study, the future study will attempt to understand: what strategy work is carried out in an organization to share, disseminate, and transfer TK; what tools practitioners use to practice TK they possess; who are strategy practitioner that possess useful TK to do strategy work. Future research that emphasize A, B, and C will widely contribute to our understanding of TK as an enabler and constraints of strategizing.

References

1. Wah, L.: Making knowledge stick. Management Review, May 1999, pp. 24–29 (1999)
2. Grant, R.: Toward a knowledge-based theory of the firm. Strateg. Manag. J. **17**, 109–122 (1996)

3. Nonaka, I., Takeuchi, H.: The Knowledge-Creating Company. Oxford University Press, New York (1995)
4. Dalkir, K.: Knowledge Management in Theory and Practice (2nd edn). MIT Press, Cambridge, MA, USA (2011)
5. Barney, J.: Firm resources and sustainable competitive advantage. J. Manag. **17**(1), 99–120 (1991)
6. Nonaka, I.: "The knowledge-creating company", Harvard Business Review, vol. 69, no. 6, pp. 96–104 (1991)
7. Grant, R.M.: Organizational capabilities within a knowledge-based view of the firm. Paper presented at the Annual Meeting of the Academy of Management, Atlanta, Georgia (1993)
8. Spender, J.-C.: Competitive advantage from tacit knowledge? Unpacking the concept and its strategic implication. Best Paper Proceeding, Annual Meeting of the Academy of Management, Atlanta, Georgia (1993)
9. Jarzabkowski, Balogun: Seidl: Strategizing: The challenges of a practice perspective. Hum. Relat. **60**, 5–27 (2007)
10. Jarzabkowski, P.: Strategy as Practice. SAGE, London (2005)
11. Johnson, G.A. Langley A., Melin L., Whittington R.: Strategy as Practice: Research Directions and Resources, Cambridge University Press (2007)
12. Isabella, L.A.: Evolving interpretations as a change unfolds: How managers construe key organizational events. Acad. Manag. J. **33**(1), 7–41 (1990)
13. Maitlis, S.: The social processes of organizational sensemaking. Acad. Manag. J. **48**(1), 21–49 (2005)
14. Meyer, J., Rowan, B.: Institutionalized organizations: formal structure as myth and ceremony. Am. J. Sociol. **83**, 340–363 (1977)
15. Maitlis, S., Lawrence, T.B.: Orchestral Manoeuvres in the Dark: Understanding Failure in Organizational Strategizing. J. Manag. Stud. **40**, 109–139 (2003)
16. Regner, P.: Strategy-as-Practcice and Dynamic Capabilities: Steps Towards a Dynamic View of Strategy. SAGE Publication, **61**, 565–588 (2008)
17. Mantere, S.: Strategic practices as enablers and disablers of championing activity. Strateg. Organ. **3**, 157–184 (2005)
18. Balogun, J., Johnson, G.: Organizational restructuring and missle manager sensemaking. Acad. Manag. J. **47**, 523–549 (2004)
19. Samra-Fredericks, D.: Strategizing as lived experience and strategists' everyday efforts to shape strategic direction. J. Manag. Stud. **40**, 141–174 (2003)
20. Jarzabkowski, P.: Strategy as practice: Recursiveness, adaptation, and practices-in-use. Organ. Stud. **25**, 529–560 (2004)
21. Drucker, P.: Knowledge-worker productivity: The biggest challenge. Calif. Manag. Rev. **41**, 79–94 (1999)
22. Quinn, J.B.: Intelligent enterprise: A knowledge and service based paradigm for industry, p. 254, The Free Press, New York (1992)
23. Reich, R.: The Work of Nations. Vintage Press, New York (1992)
24. Nonaka, I.: A dynamic theory of organizational knowledge creation. Organizational Science (1994)
25. Blackler, F.: Knowledge, Knowledge Work and Organizations: An Overview and Interpretation. The Management school, Lancaster, UK (1995)
26. Polanyi, M.: Personal Knowledge: Towards a Post-Critical Philosophy. Routledge, London (1962)
27. Winter, S.G.: Knowledge and competence as strategic assets in the competitive challenge: Strategies for inductrial innovation and renewal. Teece D.J. (ed.), 159–184, Ballinger, Cambridge, MA (1987)
28. Hall, R.: A frame for linking intangible resources and capabilities to sustainable competitive advantage'. Strateg. Manag. J. **14**, 607–618 (1993)
29. Teece, D., Gary, P.: The dynamic capabilities of firms: an introduction. Ind. Corp. Change **373**, 537–556 (1994)

30. Grant, R.M.: Toward a knowledge-based theory of the firm. Strateg. Manag. J. **17**, 109–122 (1996)
31. Nonaka, I., Byosiere, P., Borucki, C., Konno, N.: Organizational knowledge creation theory: A first comprehensive test. Int. Bus. Rev. **3**, 337–351 (1994)
32. Nonaka, I., Konno, N.: The concept of Ba: Building a foundation for knowledge creation. Calif. Manag. Rev. (1998)
33. Walsh, J.P., Ungson, G.R.: Organizational memory. Acad. Manage. Rev. (1991)
34. Collins, H.M.: The structure of knowledge. Soc. Res. **60**(1), 95–116 (1993)
35. Mintzberg, H.: Managers not MBAs. FT Prentice Hall, London (2004)
36. Whittington, R.: Learning more from failure: Practice and process. Organ. Stud. **27**, 1903–1906 (2006)
37. Whittington, R.: The work of strategizing and organizing: For a practice perspective . Strateg. Organ. **1**, 117–125 (2003)
38. Chia, R.: Strategy-as-practice: reflections on the research agenda. Eur. Manag. Rev. **1**, 29–34 (2004)
39. Ezzamel, M., Willmott, H.: Rethinking strategy: contemporary perspectives and debates. Eur. Manag. Rev. **1**, 43–48 (2004)

Effective Corporate Communication: A Solution to Foster New Product Idea Generation Dynamics

Syeda Asiya Zenab Kazmi, Marja Naaranoja, Juha Kytölä and Jussi Kantola

Abstract To make critical decisions, organizational leaders ensure to collect and analyze information through various sources by employing variety of analytical tools. Consequently, they manage to integrate the results of their analysis to offer diagnostic view by pinpointing the weak areas. Following the above sequence of analytical procedure, the current study presents a diagnostic review of highlighting weak operational areas in a European multinational company. The study findings suggest that the critical gaps are causing communicational breakdown and consequently affecting new product idea mechanism. Such operational areas include; the potential of target company's internal communication system, data collection and record keeping capability, management's approach to harness corporate potential of new idea generation and employee empowerment mechanisms. The referred areas are directly linked to the target company's new product idea generation initiatives, the activities linked to the introduction of innovative products and service styles as well as the overall operational growth.

Keywords Effective communication · Organizational leaders · Idea support mechanism · Internal communication · Employees' empowerment

S.A.Z. Kazmi (✉) · M. Naaranoja · J. Kytölä · J. Kantola
University of Vaasa, 65101 Vaasa, Finland
e-mail: akazm@uva.fi

M. Naaranoja
e-mail: marja.naaranoja@uva.fi

J. Kytölä
e-mail: juha.kytola@uva.fi

J. Kantola
e-mail: Jussi.Kantola@uva.fi

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1 Introduction

According to the surveys conducted in 1997 [1, 2] new products introduced during the period of five years from 1992 to 1997, contributed as much as 50 % of the total revenues and profits, though at the same time, the new product failure rate remained high. To be more specific, an estimated 46 % of the resources that companies devote to the conception, development and launch of new products go to projects that do not succeed and either fail in the market place or never make it to the market [3]. In the light of above, this study survey has attempted to explore the significance of transformational leadership and strategic thinking capacity building initiatives in an energy sector organization. This transformational process is evaluated through the feedback received from the target company's selected employees, representing product development teams or associated operational workforce with reference to new product development (NPD) idea generation process. In this context, the study starts with literature review of new product development idea generation and effective communication process, and later will go on to develop study hypotheses. The research methodology, analyses of results and research model formation will take place at the advanced level. Finally, the results of the current study will be analyzed in detail.

2 Conceptual Roots of New Product Idea Generation and Effective Communication

2.1 New Product Idea Generation

Taking lead in introducing innovative products by crafting effective product development processes is today's greatest challenge for industries while facing tough global competition. Modern companies can strengthen their internal processes by obtaining new product ideas from external resources by intelligently utilizing their internal capabilities [1–3].

However, Kamien and Schwartz [4] negate the above proposition by pointing out the difficulties of innovation under tough market competition due to which the tendencies of a company to innovate become seriously hampered and sometimes come to a complete halt. It is desired that a new product or service must hold a "wow" factor or 'aha moment' [5] by offering something that is missing from the range of products already available in the market. Conceiving such a new product idea seems beyond the reach of most of the companies today. Thomas and Carroll [6] stressed the significance of human cognition and linked their definition of product design thinking to the intellectual approach or the intent of the product designer. They supported their notion by stating that the design occurs when a problem-solver tries to solve the problem or acts as there is some indecision in the aims, initial conditions or allowable transformation. This results in connecting the

industry with its customers by making them an integral part of the entire NPD process i.e., scoping, product definition, development, validation, and beyond.

2.2 *Effective Communication*

Communication is a very basic requirement to initiate any mutual action between 2 or more individuals or groups [7]. Effective communication between the NPD team members during the process of new product development. This can be achieved by sharing information among the NPD team members and organizing project meetings [8–12]. According to Peter Drucker [13] and Edward Deming, [14] fear in organizations hinders innovative initiatives, effective communication and the overall performance. In addition, organizational leaders and managers must acknowledge the fact that periodical information systems evaluation and the upgrading of communication systems [15] ensure global project success. This approach is directly connected to the process of organizational "information technology-enabled" service exchange through organizational interactions (i.e. local vs. global) to ensure effective partnership to guarantee value co-production. The notion of democratizing product innovation by empowering customers to take a greater role by taking more of an active stake in corporate NPD [16] has gained attention over the years. Such thinking in NPD practices encouraged many companies globally (e.g. Adidas, BMW, Ducati, Procter and Gamble, 3 M) to involve their customers and other stake holders to incorporate their customers' innovative new product ideas into NPD processes more actively, directly, and systematically. After discussing the concepts of NPD idea generation and effective corporate communication, the authors will formulate main research questions in the next paragraphs.

3 Research Methodology

Assessment of the subject company's transformational leadership potential linked to strategic thinking capability is carried out by employing quantitative research methodology [17–19]. The main aim of the research study was to investigate the following dimensions;

- *Research Question A*: How adaptive is this organization towards designing supportive new product development idea generation processes?
- *Research Question B*: How effectively did this organization applied effective communicational approach in this organization to support product idea generation processes?

The study is supported through qualitative research in the form of interviews to offer freedom of idea sharing to the study participants. The referred qualitative approach is applied by putting together this organizational case study through in person and email based interview questionnaire. The scope of this study takes into account 10 selected professionals each from its three international locations: Finland, the UK, and Norway on the basis of their professional expertise and operational relevance. In addition, all the three work locations are engaged in producing separate nature of products or services; i.e. Finland—Power engine, Norway—Marine-shipyard support and solutions and the UK—Environment sustainability solutions respectively. The selected study respondents represented new product development work operations.

3.1 Qualitative Survey Tool

The interview questions broadly covered the investigative areas of the research study that are as follows:

i. New product development and customer value,
ii. Company's knowledge creation potential,
iii. Company's innovative potential,
iv. Company's potential to celebrate new idea creation process.

The interview questionnaire having 10 questions was administered to selected personnel of the subject company.

4 Results and Analysis

A few examples of respondent's statements confirming weaknesses in the target location's communicational setup, gathered through qualitative tool, are as follows;

One response to a question related to employee recognition for the efforts of new knowledge creation was that "New ideas are highly appreciated at departmental level but not recognized much at the higher level". Another response by a study respondent was that "New initiatives are recognized but the rewards are not visible" [20–23]. A point raised by one interviewee was that "There are people who listen but it doesn't happen so much, or it is a long process to introduce new ways of working. We also struggle with a stiff bureaucracy".

An opinion by one interviewee suggested that the (management initiatives) "should be more encouraging. If you create a patent you get some recognition. This is not easy as we are locked into the process descriptions and directives". A critical opinion by one interviewee suggested that "Company seems to have its own ways of doing things and these ways are strongly defended by many people. It seems that

many do the job/execute the tasks by strictly following the standard operating procedures, though that these might not be the best practices. Based on this lack of flexibility one would say that it is not easy to introduce new ways of doing things. It will be a battle for change". At one instance the response was: "The way of handling new ideas is too bureaucratic". One team member pointed out that "The information available at the internal information systems is outdated." And one response was that "Currently there is no common internal communication system available in working condition". A respondent additionally reported that "As far as I know, we do not have any structured way of storing ideas for later utilization. The best ideas and technologies are implemented into the new products according to what is considered suitable without too high risk taking (technology readiness level), but there is no structured way of storing the "left over ideas" that it could be feasible to utilize later on (after technology validation)".

The view of an interviewee on the company's internal communication system was that, "(The) Company has a homepage … i.e. design guidelines and standards can be found there but a lot of information is outdated". Another response received on the area was that, "(The) Company has a document management system in which information should be stored. It may not always be so easy to find what you are looking for there". Furthermore, a respondent suggested that "currently the information is stored on a server with limited possibilities for searching and indexing files or reports". One respondent notified that "Knowledge sharing is always difficult. It is difficult to know what channels to use".

5 Discussion on Results

For modern industries, "market intelligence" supported through effective communication is the core ingredient of NPD innovation activity [24–26]. Communication in an organization is defined as a process of one-to-one or interpersonal communication, between individuals. Such communication may take several forms. Messages may be verbal (that is, expressed in words), or they may not involve words at all but consist of gestures, facial expressions, and certain postures (i.e. also termed "body language"). Nonverbal messages may even stem from silence. Market intelligence is the information relevant to a company's markets, gathered and analyzed specifically for the purpose of accurate and confident decision-making in determining strategy in areas such as market opportunity, market penetration strategy, and market development. Hence, the overall innovative activity associated with the process of new product idea generation is always associated with an individual's knowledge base. Hence, it is also possible that a designer (or, perhaps, an observer during the overall product development process) may identify a new area of research while focusing on his own [5, 26–28].

5.1 *Response to Research Question A: How Adaptive Is This Organization Towards Designing Supportive New Product Development Idea Generational Processes?*

It is observed that there are numerous areas that require attention and refinement to support the subject company's NPD idea generation initiatives and capabilities [11, 17, 26]. Initially, more practical initiatives by the management are required to honor and acknowledge the efforts of new idea generators. In addition, the role and involvement of innovative media options must be enhanced to create effective connections between the company (i.e. through its various work units) and its external stake-holders. Greater level of efforts are required by the company's management to enhance their work teams' knowledge base and understanding of the market as well as the customer needs in order to establish strong customer dependence on the company's products and services through reliability. Additional focus and effort level is required from the company's management to enable flexibility in the company's production and service solutions capabilities [24, 25]. Furthermore, the information sharing among various work roles and functional levels in addition to the process phases should be made convenient. It is additionally recommended that the subject company's ability to reach all types of stake holders should be enhanced further. The company's management should introduce a periodical job rotation policy (i.e. across functions as well as across borders) to make their work team members more capable of multitasking, alert, knowledgeable and responsible for the work areas across various functions and work roles. New processes should be formulated and implemented to enhance and ensure speedy response inflow from the sales networks to the services or repair and maintenances units. Finally, there is a major need to install effective sales and after sales communication networks additionally involving research and development, design and product manufacturing lines to support the subject company's innovation initiatives.

5.2 *Response to Research Question B: How Effectively Did This Organization Applied Effective Communication Principles in This Organization?*

The study's quantitative as well as qualitative data analysis highlighted obvious weak areas in the subject company's environmental openness and internal communication systems. To cover these gaps it is recommended that an enhanced level of cross functional communicational flow and frequent knowledge sharing opportunities be ensured, especially involving research and development, design and engineering departments. Furthermore, an increased level of organized and scheduled cross functional team coordination is required in addition to relying on

electronic communication methodologies (i.e. emails, webinars, etc.). Furthermore, more frequent Skype meetings and webinars should be arranged, involving the subject company's globally scattered teams to support international projects and enhanced team coordination.

The survey data analysis highlighted that the subject company is currently unable to implement and utilize the potential of its internal communication systems due to either having obsolete data or currently having insufficient operational capacity. Hence, it is highly recommended that the subject company update its communicational systems and data bases. In addition, quick upgrading or trouble shooting upon user request is required. Furthermore, communication system alterations, improvements, and the inclusion of additional features (e.g., system based corporate report, generation upon user requests should be implemented promptly) in the current communication system is highly recommended. It is further recommended that the subject company adopt a unified procedure for application usage so as to ensure standardized, one-feel, documentation. The use of ICT based applications and databases should be made compulsory for all data management and for all concerned so as to ensure a single platform for information search and sharing. There should be strict but user friendly guidelines for information and document archiving. In addition, data accessibility should be made efficient, and user friendly. Finally, the work teams must be encouraged to use the system applications and databases more frequently and efficiently through the support of system related trainings to handle the databases and systems significantly. Furthermore, better control over communication issues due to language barriers, moderately responsiveness and unclear job description/responsibilities should be ensured. In the light of above findings, the authors propose following NPD idea evaluative process for the target company.

Figure 1 reflects in detail the ideal process model to support the proposed theoretical framework extension presented in the current research study through especially highlighting the evolution of the NPD related idea as well as evaluation cycle. According to the above, the reader can clearly view the relation among various NPD process stages. The process starts by taking the new product development related feeds through internal and external environment clues. The next stage comes when the clues are merged together to give birth to a new product or process related idea with the support of transformational leadership and strategic thinking factors. Further, this product related idea crosses various stages including formal new product or process related idea formation, the refinement process stage, then the formal development process starts, which later takes the form of either a product which is ready to be tested and launched or a formation of a product development related process. Finally, the new product goes to the market as a new and useful creation, gets evaluated through real time market testing and in return becomes the source of customers' feedback. Such market feedbacks further generate new product related ideas and this cycle goes on and on. On the other hand, if the idea is related to the formation of any new product process, then it goes to the organizational process formulation stage (i.e. through discussions and brainstorming etc.), and if accepted, then it is implemented after the necessary testing as a useful process; consequently it

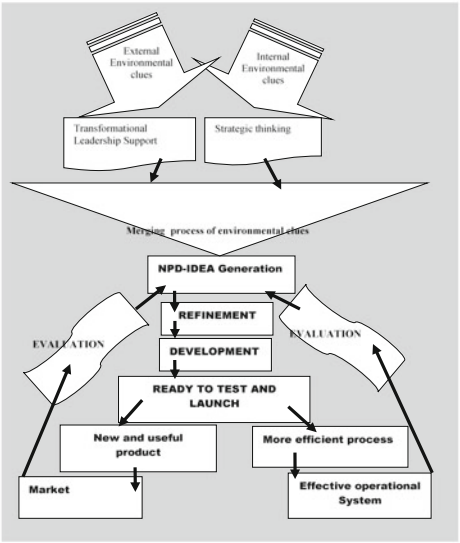


Fig. 1 Proposed model's evaluation process

becomes part of the effective operational system. After evaluation, the newly approved process may further work as the source of generating new process related ideas to keep such a thought process cycle alive and running. Accordingly, the qualitative and quantitative data analysis revealed possible room for improvement related suggestions in the area of new product development stage gate process upgrade. According to the respondent's feedback, the current situation is reported as "case to case basis" with no formal new product stage and gate process being adopted. Hence, the following three sets of new product development activities with reference to each one of the studied location are formulized:

Figure 2 reflects the product associated with the Finland site office along with its allied processes and operational motives. The details displayed in columns 1–4 are in accordance with the respondents' feedback. The product category linked to the mentioned work site is energy or power related. The responses by respondents through the implementation of qualitative tool reflected the site's reactive approach towards the new product development since the major sources of the product ideas are customer's feedback and the V2 notifications from the factory. The site office is dependent on certain regulations and standards (i.e. emission standards) that reconfirm the reactive product development approach. The reflection of the stage and gate process, as reported by a study representative, includes the stages which are highlighted in bold format while those which are not highlighted are parts of the recommended set as well but usually get overlapped in the overall new product development process keeping in view the nature or category of the product.

Figure 3 displays the information related to the product associated with the Norway site office. The information further highlights the product's current baseline processes as well as its operational objectives. Here again, the details displayed in

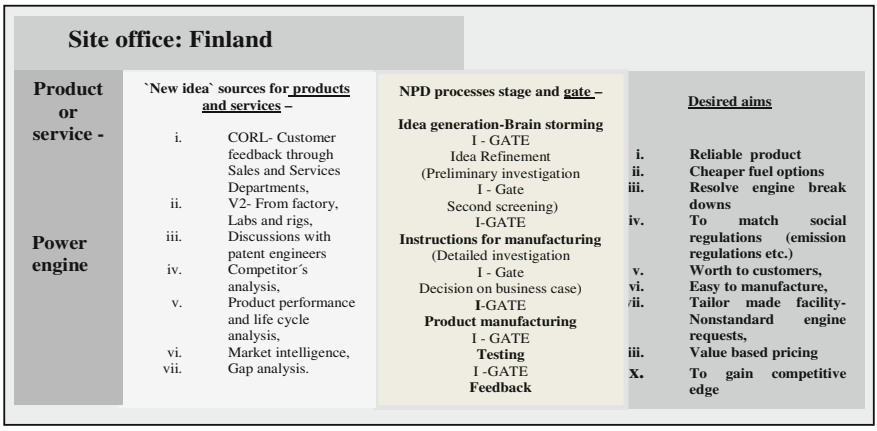


Fig. 2 Summary of NPD process at the targeted site office in Finland

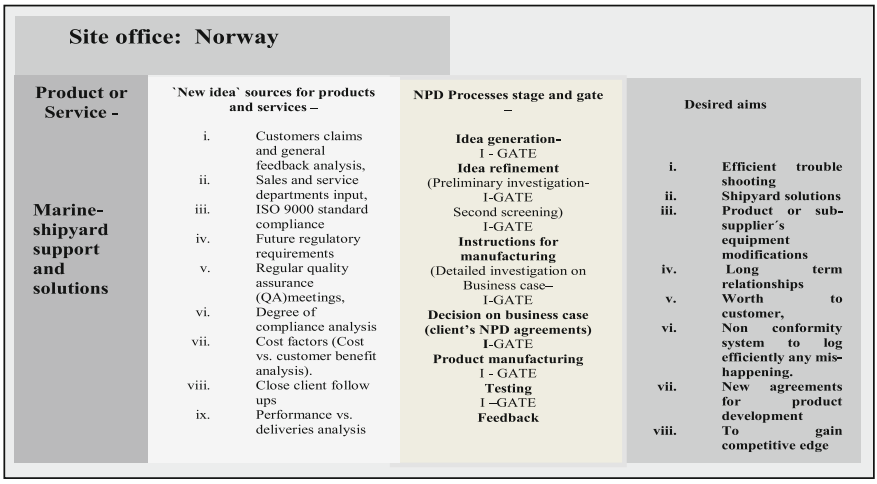


Fig. 3 Summary of NPD process at the targeted site office in Norway

columns 1–4 are linked to the product category (i.e. marine—shipyard solutions) of the mentioned work site. The reflection of the actual stages and gates process includes the ones highlighted in bold format while the ones which are not highlighted are those which are part of the recommended NPD process set but usually get overlapped in the entire new product development process, keeping in view the nature or the product category.

Figure 4 displays the product associated with the site office in the UK along with its linked processes and operational objectives. Here, the details displayed in columns 1 to 4 are linked to the product category (i.e. environment sustainability

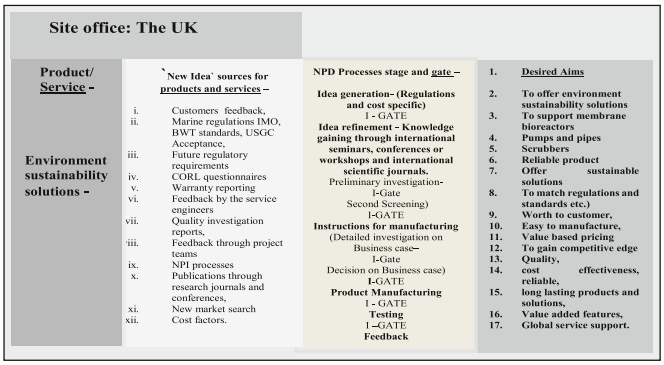


Fig. 4 Summary of NPD process at the targeted site office in the UK

solution) related to the mentioned work site. Figure 4 is formulated on the basis of actual data reflecting in 'bold' the stages and gates in placed at the referred site. However, the stages that are not highlighted are those that are the part of the recommended NPD set of processes but are usually overlapped in the overall new product development process due to the nature or category of the product. New product development process remains central and very critical to any industry. It reflects a company's approach towards the new product opportunity. Through leadership and strategic thinking capabilities, a company's management and its work teams can sharpen their potential to react to the market opportunities by carving out smart, suitable and product category specific NPD processes.

Having a close look at all the three figures reflecting the three targeted work locations (Finland, Norway and the UK), it is recommended to implement separate stage gate processes implementations, keeping in view the differences in the product categories (i.e. energy, marine and environmental sustainability), its nature and production process requirements, to support innovation initiatives while taking care of the issues associated with NPD team dynamics (i.e. effective communication, team empowerment, effective control over resources, etc.). For instance, the products (i.e. environmental sustainability solutions- scrubbers, pumps and valves, etc.) of the site office in the UK are innovative solutions newly introduced globally. It is a global directive and highly cost driven as well. Such products and services require more global market attention or dissemination at the initial production stages than the regular products and solutions related to power and energy or marine and shipyard issues. The difference can also be understood in terms of the nature of the stakeholders associated with each of the product categories. Environmental sustainability solutions and products are directly associated with global policies, standards and regulations, while energy solutions or marine solutions are mainly linked to social regulations and local standards and requirements. Similarly, power or energy solutions and products have more margins of manufacturing freedom and production based on innovative features (i.e. power engines, light machines or heavy and smart power plants, etc.). In all the three product categories associated

with the three targeted sites, there are obvious differences in terms of product scope, manufacturing requirements, customer base and other stakeholders. This supports a clear requirement, based on the concepts of leadership and strategic thinking, to suggest designing three different sets of new product development stage gate processes to support each product category. It is anticipated that once the discrepancies highlighted through the study's quantitative and qualitative data analysis are rectified and the targeted locations are supported through the product category specific stage gate processes, there will be an obvious positive change in the productivity and efficiency levels of the said target locations.

While exploring suitable measures to propose or formulate product nature specific separate stage gate models, the company's research teams can follow the examples of other manufacturing concerns as guidance: (e.g. Xerox; for Xerography, and Black and Decker for power tools) following Corning's Five-Stage, Stage- Gate process; i.e. Stage 0: Discovery; Stage 1: Scoping; Stage 2: Building a Business Case; Stage 3: Development; Stage 4: Testing and Validation; and Stage 5: Launch [29–31] and an innovative approach to gain market lead through corporate product innovation strategies supported by the concept of strategic leadership [31]. In addition, the companies could modify the basic new product development stage and gate processes according to their requirements and resources, the customers' needs and the nature of the products they are offering; e.g. United Technologies Corporation used variants of the stage gate processes to design helicopters and jet engines while ITT Industries, used to follow a staged process with progressive freezes to design military radios and satellites [32]. The stage gate process is an effective tool for accelerating incremental product development. Furthermore, it cannot be directly used for fuzzy front end (FFE) in case of platform or breakthrough products. Platform products (i.e. following a multi-market, multi-product strategy) need to begin with a strategic vision which will lead to a family of products based on an in-depth understanding of the market and how the company's core competencies and capabilities may be used to build competitive advantage [31].

6 Conclusion

This study is significant in terms of new knowledge creation and has examined the effects of effective communication principles to harness new product idea generation potential in one European energy sector company, while studying its current new product development proficiency at its three sites (Finland, the UK, and Norway). The research process highlighted operational gaps and suggested measures for improvement in its current working practices linked to effective communication process to support new product development idea generation process. Since no formal unified stage gate process is currently followed at the target locations to offer comparative basis for NPD process analysis, evaluation and control for organizational productivity and profitability.

References

1. Griffin, A.: PDMA Research on new product development practices: updating trends and benchmarking best practices. J. Prod. Innov. Manage. **14**, 429–458. Henderson and Reavis, 2008 (1997)
2. Ozer, M.: A survey of new product evaluation models. J. Prod. Innov. Manage. **16**(1997), 77–94 (1997)
3. Ottum, B.D., Moore, W.L.: The role of market information in new product success/failure. J. Prod. Innov. Manage. **14**, 258–273 (1997)
4. Kamien, M.I., Schwartz, N.L.: Market Structure and Innovation, 241 p. Cambridge University Press (1982)
5. Dorst, K., Cross, N.: Creativity in the design process: co-evolution of problem-solution. Des. Stud. **22**, 425–437 (2001)
6. Thomas, J.C., Carroll, J.M.: The psychological study of design. Des. Stud. **1**, 5–11 (1979)
7. Berko, Roy M., et al.: Communicating, 11th edn, pp. 9–12. Pearson Education Inc, Boston, MA (2010)
8. Balachandra, R., Brockhoff, K., Pearson, A.W.: R&D project termination decisions: processes, communication, and personnel changes. J. Prod. Innov. Manage. **13**, 245–256 (1996)
9. Ebadi, Y.M., Utterback, J.M.: The effects of communication on technological innovation. Manage. Sci. **30**, 572–585 (1984)
10. Rothwell, R., Freeman, C., Horlsey, A., Jervis, V.T.P., Roberston, A.B., Townsend, J.: SAPPHO updated—project SAPPHO phase II. Res. Policy **3**, 258–291 (1974)
11. Souder, W.E., Chakrabarti, A.K.: The R&D/Marketing interface: results from an empirical study of innovation projects. IEEE Trans. Eng. Manage. EM **25**, 88–93 (1978)
12. Thamhain, H.J.: Managing technologically innovative team efforts toward new product success. J. Prod. Innov. Manage **7**, 5–18 (1990)
13. Flaherty, J.E.: Peter Drucker: Shaping the Managerial Mind, 464 p., Incorporated. Wiley (1999). ISBN 0-7879-4764-4
14. Edwards, D.W.: Out of the Crisis. MIT Press (1986)
15. DeLone, W.H., McLean, E.R.: The DeLone and McLean model of information systems success: a ten-year update. J. Manage. Info. Syst. **19**(4), 9–30 (2003)
16. Von Hippel, E.: Democratizing innovation. MIT Press, Cambridge, MA, Available at SSRN http://ssrn.com/abstract=712763 (2005)
17. Kazmi, S.A.: Conquering environmental inconsistencies during the new product development (NPD) activity lead to corporate sustainable success'. Proceedings of the 3rd International Conference on Industrial Engineering and Operational Management (IEOM-2012), July 3–6, pp. 2552–2559. Istanbul, Turkey (2012)
18. Kazmi, S.A.Z., Kinnunen, T.: Deep leadership coaching effectiveness in a corporate scenario, constitutes proactive leadership solution for 'Optimal Team formation'. Euro. J. Soc. Sci. (EJSS). **31**(2), 166–189 (2012). ISSN: 1450-2267
19. Kazmi, S.A., Naarananoja, M., Kytola, J.: Harnessing new product development processes through strategic thinking initiatives. Int. J. Strateg. Decis. Sci. (IJSDS) **6**(3), 28–48 (2015). doi:10.4018/ijsds.2015070103
20. Kazmi, S.A., Naaranoja, M.: Cultivating strategic thinking in organizational leaders by designing supportive work environment!. Procedia—Soc. Behav. Sci. **181**, 43–52 (2015). doi:10.1016/j.sbspro.2015.04.864
21. Kazmi, S.A., Naaranoja, M.: Fusion of strengths: T-style thinkers are the soul savers for organizational innovative drives and the allied change processes. Procedia—Soc. Behav. Sci. **181**, 276–285 (2015). doi:10.1016/j.sbspro.2015.04.889
22. Kazmi, S.A., Naaranoja, M.: Innovative drives get fuel from transformational leadership's pied pipers' effect for effective organizational transformation!. Procedia—Soc. Behav. Sci. **181,** 53–61 (2015). doi:10.1016/j.sbspro.2015.04.865

23. Kazmi, S. A., Takala, J.: Aiming for effective industrial operational management through transformational leadership—quest for the best fit as an optimal team!. In: Proceedings of the 10th International Conference of the Academy of HRD (Asia Chapter), Kuala Lumpur, Malaysia, 3–6 Dec (2011). ISBN: 978-967-960312-5
24. Kazmi, S.A., Takala, J.: Individual differences in work force substantiate greater levels of operational responsiveness through transformational leadership. In: International Conference on Business Strategy and Organizational Behavior (BizStrategy), pp. 50–55. Bali, Indonesia (2012)
25. Kazmi, S.A., Takala, J.: Entrenching strategic competitive advantage through transformational leadership!. In: 3rd International Conference on Industrial Engineering and Operations Management, pp. 2517–2526. Istanbul, Turkey (2012)
26. Kazmi, S.A., Naaranoja, M.: Comparative approaches of key change management models—a fine assortment to pick from as per situational needs!. In: Presented in the 3rd annual international conference(s) organized by business strategy and organizational behavior (BizStrategy 2013) (2013). Print ISSN: 2251–1970, E-Periodical ISSN: 2251-1989, doi:10.5176/2251-1970_BizStrategy13.41
27. Kazmi, S.A., Naaranoja, M.: Connecting individual differences in workforce to organizational creativity through transformational leadership for corporate transformational effectiveness. Open J. Leadersh. **2**(4), 73–77 (2013b). doi:10.4236/ojl.2013.24010
28. Kazmi, S.A.Z., Naaranoja, M., Takala, J.: Diverse workforce supported through transformational leadership ensures higher operational responsiveness. Glob. Bus. Rev. **2**(4) (2013). (Print ISSN: 2010-4804, E-periodical: 2251-2888), doi:10.5176/2010-4804_2.4.253
29. Thakur, S.: In: Ritcher, L. (ed.) Overview of Corning's Five-Stage Stage-Gate Process. Bright Hub PM. http://www.brighthubpm.com/methods-strategies/81959-overview-of-cornings-five-stage-stage-gate-process/#imgn_0 (2011). Retrieved on 3 March 2014
30. Crawford, C.M., Di Benedetto, C.A.: New Products Management, 10th edn., 592 pages. McGraw-Hill/Irwin (2010)
31. Koen, P.A.: The fuzzy front end for incremental, platform, and breakthrough products. In: PDMA Handbook of New Product Development, 2nd edn., pp. 81–91 (2004)
32. Unger and Eppinger: Improving product development process design: a method for managing information flows, risks, and iterations. J. Eng. Des. **22**(10), 689–699 (2011)

A Manager's Means to Motivate Experts at Work

Johanna Koskialho

Abstract Motivated employers are vital for all companies. Motivation can be affected by using extrinsic and/or intrinsic motivators. However, intrinsic motivators offer more versatile options and are significantly more efficient. Intrinsic motivation is especially important to experts. Mangers can affect and develop the motivation of experts in several ways. The results of this survey are in line with motivation theories. The study highlighted work satisfaction and significance and importance of work. The opportunity to plan and complete work tasks are considered important. The personnel want to have the kinds of duties that give them satisfaction and feelings of progress, achievement and success. Constructive feedback also surfaces as an issue.

Keywords Motivation · Personnel · Work satisfaction

1 Introduction

Motivation has been one of the central and continuous subjects in the field of phycology. Motivation creates energy, directs action and gives persistence. Motivation generates commitment to active and self-generated achievement and it is strongly linked in performance, well-being and coping with the workload. This means that motivation has a strong effect on efficiency and operations in organizations. By understanding and applying motivation theories, it is possible to create value through people, since motivated employees are willing to commit to do their best and thus add to the organizational performance significantly. Thus, even minor means to affect motivation of personnel can create notable change is organizations [1–3].

Motivation of the personnel is a key element in achieving high performance in organizations. This means understanding how individuals can be motivated by using such incentives as leadership, compensation, the work they are doing and the

J. Koskialho (✉)
Tampere University of Technology, Pohjoisranta 11, 28101 Pori, Finland
e-mail: j.koskialho@gmail.com

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environment where that work is carried out. The goal is to develop the motivation process that ensures the work tasks are performed in ways that meet the expectations of the management [1].

2 Means to Support Motivation

Motivation develops internally and it is unlikely to motivate someone directly. However, managers can affect the motivation of the personnel by using leadership and interaction. Motivating is not about controlling but enabling experiences, circumstances, possibilities and events in such ways that they increase a person's motivation. By recognizing factors that enhance motivation and avoiding those that reduce it, organizations can create conditions for motivating [4, 5].

According to Ford [6], motivating means enabling or facilitating something. Motivating is not about controlling but enabling experiences, circumstances and possibilities is such ways that they most likely add or develop person's motivation. A person's goals, feelings and beliefs affecting their actions are the basis of motivation and each of them must be taken into account in order to make motivating possible.

2.1 Extrinsic Motivators

Extrinsic motivation factors consist of different compensation policies, bonuses, options, personnel funds and gifts. One of the biggest challenges that companies face is to create and develop a motivational compensation system. The motivational potential of compensation is dependent on how much a person earns: the less the salary, the more essential is the amount. When the level of compensation rises, it increases person's identification to work itself and reduces the meaning of the money [2, 7].

A realistic compensation policy is a necessary precondition when increasing the productivity and renewing the workforce. When used in right ways, compensation can act as a motivator; on the other hand, an incoherent compensation policy damages the ability of a given organization to motivate personnel. The motivation effect of compensation bases on those psychological meanings it gives to a person. It is not about the material value but the influence it has on strengthening person's self-esteem [8]. A good compensation policy must have three principles: the level of compensation needs to be competitive; it needs to take into account the importance of the work, performance level and the length of the employment; and it has to be bound to improvement of performance and to reward that [9].

2.2 Intrinsic Motivators

Intrinsic motivation consists of the things that motivate in work itself and the inner rewards that are achieved through work. People have a need to perform well at work and they wish to get feedback on their actions. In addition, there is a need to feel that the work itself is meaningful. People also have a need to feel social cohesion and autonomy, to feel that there are ways to affect the work and the ways it is carried out. Intrinsic motivators offer plenty of opportunities. Supporting intrinsic motivation is especially important to experts. They want to see their work as a part of the larger entity and see the results of their work. Expert work requires autonomy. Managers can support the work of experts by defining clear authority and responsibility policies, offering enough leeway and monitoring development by using feedback and communication [2, 4, 10].

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Several factors trigger and shape intrinsic motivation. Self-Determination Theory distinguished three needs which are creating and shaping intrinsic motivation [11]. These needs are need of competence, social cohesion and autonomy. Pink [12] suggested there are three principles resulting in intrinsic motivation: autonomy, mastery and purpose. According to Maccobyn [13] intrinsic motivation can be enhanced by using 4R-principle. These principles are responsibility, relationship, rewards and reasons.

Thomas [14] suggested that person's intrinsic motivation can be supported by four "blocks": Meaningfulness, choice, competence and progress. By utilizing these blocks managers have several means to support the motivation of their subordinates but also subordinates have active role. Subordinates share information, purpose their own interpretations of events and negotiate with their colleagues and managers in order to change the work duties. Thus, creating intrinsic motivation is cooperation between managers and team members.

According to Hackman's [15] theory, intrinsic motivation at work is dependent on three preconditions which are called critical psychological states. At first, an individual needs information concerning the results of the work carried out. If the work or tasks have been planned in such ways that they do not enable estimating whether the work has been carried out well or poorly, it does not offer opportunities to feel complacency or dissatisfaction. Secondly, an individual needs to feel

responsibility for the results of his or hers work and personal responsibility for achieving those results. Third, the work needs to be considered meaningful.

According to Hackeman and Oldham [15], motivation energizing through work is more dependent on task planning than the qualities of the individual who is performing them. Defined inner psychological states are internal and thus steering them directly through work or by managing it is not possible. Instead, justifiable and rational goals and measurable and adjustable work characteristics are needed and through those, critical psychological states can be improved and thus strengthen intrinsic motivation [15].

Well-performed tasks are internally rewarding, when an individual experiences competence and efficiency, intrinsic motivation and satisfaction. According to Maccoby [13] the most motivating responsibilities enhance and develop person's skills and capabilities. Thomas [14] suggested that the feeling of competence is triggered by the experience of performing a task well, which means that the expectations are met or exceeded. Also essential for motivation is how important and significant the work is considered. When the work is considered meaningful and simultaneously an individual experiences the feeling of competence, the work affects as strong motivator [2, 14].

The meaningfulness of the work: Thomas [14] defines that the meaningfulness of the work means the amount of excitement or passion the person feels towards the work or task. The excitement or passion that people have towards their work evolves and changes as time passes. It would be beneficial for organizations to connect these passions to tasks that have meaning to individuals. This requires interaction and getting to know the people. Hackman and Oldham [15] suggested that the importance of the work is defined by the influence it has on other people's lifes and whether the task affects the immediate organization or even the whole world. The task is perceived important as the individual feels that the task is beneficial for other's physical and mental well-being. The value and the meaningfulness of the work can be associated with the individual's own work, a work community or the activity of the organization. The value can arise from the affects to the customer, associates or homeland. The meaningfulness can be attached to the products or services, ideology or values [4, 13].

Autonomy: Hackman [15] defines that autonomy in a task means freedom, independence and power to decide on things like schedule and procedures. Autonomy, output and motivation are all connected. Greater autonomy results in better output as the motivation is increased. Autonomy is experienced in an environment where individual's thoughts and opinions are valued. Such an environment generates accountability in the individual for results on the decisions made. Autonomy shows in the individual as initiative, creativity, innovation and eagerness to experiment. Autonomy is internally rewarding. Reducing autonomy weakens the ability to be responsible as well as creativity and innovation. Excessive injunction and announcing things without discussion causes feelings of frustration [14, 16].

The feeling of meaningfulness and the freedom of choice are essentially connected to autonomy. An autonomous individual commits to tasks that are essential for reaching the goal. Freedom of choice allows the individual to carry out

meaningful tasks. Usage of time is enhanced and mental resources are properly utilized. Freedom of choice enables one to commit to a task, thus taking more responsibility and adding the quality of the result [2, 14].

Supporting autonomy is a source of intrinsic motivation that a manager can affect the most. Thomas [14] presents four other factors that affect how autonomous the workers find their work. These are the trust shown towards the workers; creating the sense of security which includes allowing mistakes; clear purpose; and sharing information [3].

Goals: Setting goals is a powerful tool for increasing intrinsic motivation. The steering effect of behaviour that goal setting has is based on directing the activity. The goals directs an individual to act in a manner favourable to reaching the destination. Goals make one to try harder and to commit to the task for longer. This effect improves the productivity of the organization. Goals also help to search and find new strategies for completing the task which also enhances the productivity of the work [17].

A goal should be realistic as well as optimistic. They should be sufficiently challenging yet reachable. These kind of goals require the worker to strive and they produce motivation. A task being too easy lowers motivation and output. An excessive challenge, in turn, may frustrate the worker and lower self-esteem. It is important that an individual can contribute in the process of setting the goals. A goal must be tangible, exact and clear. A measurable goal predicts better outcome. The goals are to be evolved during the process. Both long term and short term goals are to be set. This enables the motivation and performance to last throughout the process. Continuous evaluation of the progress enhances motivation and performance [2].

Individuals experiencing feelings of competence are intrinsically motivated to commit performing the task and on the contrary retreat the task if the lack of competence is experienced [18]. The competence experienced at work is also related to possibility to control the work and ability to achieve certain outcome through the work. This is very essential for work motivation. Extrinsic motivation is strongly connected to goals: one experiences competence if goals are reached or exceeded or when the is proceeding towards the goal. From the motivation standpoint, it would be important to set intermediate goals and follow progress in both work duties, as well as in skills and knowledge [2, 14].

Since well-performed work can lead to a situation where one does not feel they have enough challenges, it is important for a manager to estimate and consider whether work assignments and job descriptions provide sufficient challenges. If needed work assignments should be modified to give greater opportunities to learning and developing. Job descriptions can be broadened or the employee can be given more authority in current tasks. According to Thomas [14], competence can be supported and developed by using knowledge, positive feedback, acknowledging skills and competence, challenges and high standards [2, 14].

Feedback has an essential role in steering behaviour and it can encourage one to perform more. Feedback has a strong effect on experiencing competence, and the amount of feedback affects directly how much information an individual receives from his or her work. In this study, Deci [19] perceived that positive feedback

enhances intrinsic motivation through strengthening the experience of competence when negative feedback was perceived to diminish the feeling of competence and thus decreasing intrinsic motivation.

3 Method

The survey focuses on analyzing the motivation level of a professional organization, and the aim was to discover ways for managers to effect and improve the motivation of their subordinates. The respondents were asked to evaluate different statements. They needed to evaluate the current situation and how they hoped it to be, i.e. the vision. Respondents also evaluated the importance of the claims. The fluctuation of the most significant exceptions between the current status and the vision were discovered and combined with the importance to perceive and analyze the most important issues to enhance and increase the motivation.

The study was conducted on Helix, an Evolute-based application, which was developed for measuring and evaluating the personnel commitment levels. Motivation is a part of the affective commitment component and is separated into intrinsic motivation and motivating potential of job. Helix enables motivation to be analysed separately when gaining deep understanding is possible. Evolute has been developed as an Internet application, a platform for several test applications that can be developed and responded to globally. Realistic evaluation of current level is a basis for all future visions. Creative tension, which means the distance between vision and current stage, is a force behind personal excellence. The evaluation process begins with self-evaluation. The aim is to map the personnel's own clear understanding of their motivation level. Self-evaluation is conducted by examining their thoughts and feelings.

4 Results

In general, the personnel is motivated. Both intrinsic motivation and motivating potential of job had reached high levels as illustrated in Fig. 1.

Respondents view work satisfaction as the most important thing. Also, significant and meaningful work is important. The work itself and its content come up as well as the compensation. Satisfaction that comes through work is very significant. Respondents really want to enjoy what they do and they want to perform their work well. Possibility to plan and complete work tasks are considered important. The personnel wants to have such work that gives them satisfaction and feelings of progress, achievement and success. Respondents want their work and tasks to be interesting and rewarding, and they want to have a possibility to enjoy and affect them.

Despite a high motivation level, the survey indicated issues which employees wish to be improved. Constructive feedback surfaces strongly. It is essential to

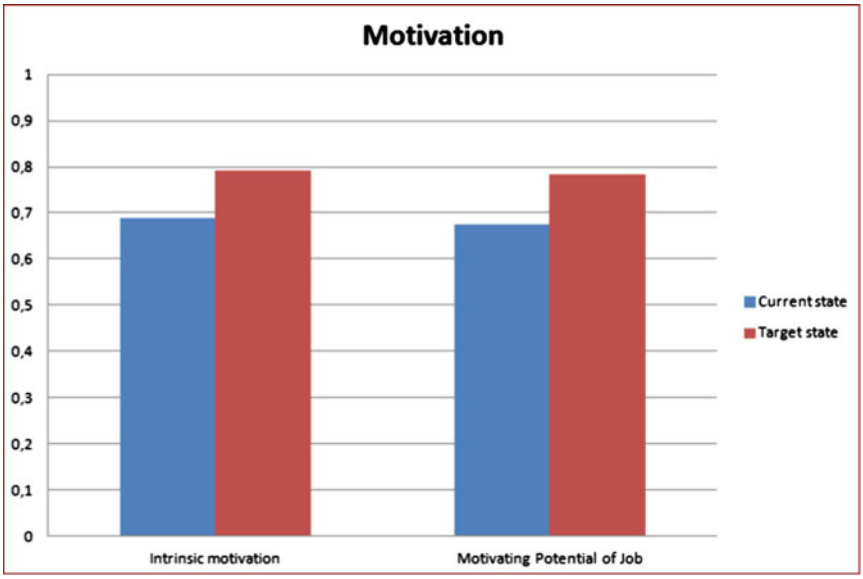


Fig. 1 Motivation level in technical department (Evolutellc/Helix/Empiirinen Data)

ensure and improve the amount of such feedback, which improves performance. Managers need to interact more actively with their subordinates and discuss the challenges they are facing and the success. Positive feedback also has a positive effect on competence.

This survey emphasized the significance of work satisfaction. However, work satisfaction interfaces with work characteristics and work arrangements. This means that satisfaction cannot be increased or developed without changing the work content. Figure 2 demonstrates the highlighted features and categorizes them hierarchically. In practice, if the goal is to develop work satisfaction or intrinsic motivation, it means that one has to concentrate on the features which trigger those things, i.e. progress, choice, meaningfulness and competence. The figure shows, for



Fig. 2 Means to develop intrinsic motivation and work satisfaction

example, that the feeling of progress is triggered by working atmosphere, milestones and positive feedback.

Recognizing and understanding the issues that personnel consider the most important ones is the key for a manager to enable and support the development of motivation. If the manager understands motivation process and the principles of motivating, motivation can be enabled and supported by enriching work content, taking advantage of work arrangements, supporting progress and competence and by giving constructive feedback.

References

1. Armstrong, M.: A Handbook of Human Resources Management. British Library Cataloguing in Publication Data 251 (2006)
2. Liukkonen, J., Jaakkola, T., Kataja, P.: Taitolajina työ. Edita Prima Oy, Helsinki, pp. 6–7, 10, 108–109, 123–127, 214–217 (2006)
3. Ryan, R., Deci, E.: Self-determination theory and the facilitation of intrinsic motivation, social development and well-being. Am. Psychol. **55**(69) (2000)
4. Hyppänen, R.: Esimiesosaaminen liiketoiminnan menestystekijänä, pp. 144, 156, 160. Edita Publishing Oy, Porvoo (2013)
5. Lampikoski, K.: Panosta avainhenkilöihin - luo kilpailuetua sitouttamisstrategialla, 37. Edita Prima Oy, Helsinki (2005)
6. Ford, E.: Motivating Humans: Goals, Emotions and Personal Agency Beliefs. Sage Publications, California (1992)
7. Wiley, C.: What motivates employees according to over 40 years of motivation surveys. Int. J. Manpower **18**(3), 275 (1995)
8. Dawson, K.M., Dawson, S.N.: How to motivate your employees. HR Mag. **35**, 78–80 (1990)
9. Timpe, D.: Mikä motivoi henkilöstöä, pp. 84–89. Amer-yhtymä Oy Weiling+Göösin kirjapaino, Espoo (1986)
10. Kontiainen, J., Skyttä, A.: Esimiehen mielityö, prosessoivan johtamisen opas, 45. Kirjapaino Oy, Innotiimi Oy, Karisto (2010)
11. Ryan, R., Deci, E.: Intrinsic and extrinsic motivations: classic definitions and new directions. Contemp. Educ. Psychol. **25**(57) (2000)
12. Pink, D.: Drive: The Surprising Truth About What Motivates Us. Riverhead Books, New York (2009)
13. Maccoby, M.: The 4Rs of Motivation. Industrial Research Institute, Inc., July-August (2010)
14. Thomas, K.: Intrinsic Motivation at Work: Building Energy and Commitment, pp. 48–50, 52, 63–67, 77–78, 80. Berrett-Koehler Publishers, San Francisco (2000)
15. Hackman, J., Oldham, G.: Motivation through the design of work: test of a theory. Organ. Behav. Human Perform. 255–258 (1976)
16. Langfred, C., Moye, N.: Effects of task autonomy on performance: an extended model considering motivational, informational, and structural mechanisms. J. Appl. Psychol. **89**(6), 935 (2004)
17. Locke, E.: Motivation through conscious goal setting. Appl. Prev. Psychol. **5,** 117–125 (1996)
18. Vallenrand, R., Reid, G.: On the causal effects of perceived competence on intrinsic motivation: a test of cognitive evaluation theory. J. Sport Psychol. **6** (1984)
19. Deci, E.: Effects of externally mediated rewards on intrinsic motivation. J. Pers. Soc. Psychol. **18** (1971)

Digitalization and Big Data Supporting Responsible Business Co-evolution

Vesa Salminen, Heikki Ruohomaa and Jussi Kantola

Abstract Circular economy as a business driver is growing in bio economy, industry and service business. That means great opportunity for all kind of businesses but at the same time a huge business transition. The opportunities of sustainability and circular economy have not been understood in full context and as new service innovation. Responsibility business management is an integrator on the path. The paradigm shift in the effective circular economy is the alteration of purchase behavior from ownership and selling of machines to offering of services. Obvious development activity is to increase the efficiency in supply network. Digitalization is rapidly increasing and enterprises must find new ways to innovate for business advantage. Through digital transformation, the use of new technologies like cloud, mobile, big data, and social networks with increasing intelligence and automation enterprises can capitalize on new business and optimization opportunities. Responsibility business leadership needs democratic innovation culture and co-innovation and co-evolution processes. This article introduces a concept tool for responsible business leadership. It helps to analyze co-evolution over the life cycle of business transition on circular economy by using Evolute, the intelligent web-based system, for managing human opinions and experiences as well as public- private-relationships and responsible business leadership capabilities.

Keywords Responsible business management · Circular economy · Digitalization · Transdisciplinary · Co-innovation · Co-evolution

V. Salminen (✉) · H. Ruohomaa
Häme University of Applied Sciences, Hämeenlinna, Finland
e-mail: vesa.salminen@hamk.fi

H. Ruohomaa
e-mail: heikki.ruohomaa@hamk.fi

J. Kantola
Department of Production, University of Vaasa, Wolffintie 34,
65200 Vaasa, Finland
e-mail: jussi.kantola@uva.fi

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1 Introduction

The World Economic Forum's report Accelerating the scale-up across global supply chains report plays a crucial role in this market evolution by exploring how businesses can use the circular economy to drive arbitrage opportunities across complex, global supply chains [1]. A circular economy is restorative and regenerative by design and aims to keep products, components, and materials at their highest utility and value at all times. The concept distinguishes between technical and biological cycles. As envisioned by the originators, a circular economy is a continuous positive development cycle that preserves and enhances natural capital, optimizes resource yields, and minimizes system risks by managing finite stocks and renewable flows. It works effectively at every scale. There is a world of opportunity to re-think and re-design the way we make stuff [2]. Re-Thinking Progress explores how through a change in perspective we can re-design the way our economy works—designing products that can be 'made to be made again' and powering the system with renewable energy. It questions whether with creativity and innovation we can build a restorative economy [3].

In order to sustain competitive advantage, manufacturing companies are expanding their product offering to lifecycle services. By doing so, these leaders are expanding their value proposition multidimensional by concurrently creating strong potential through developing more sustainable customer-engaging products, co-innovating sustainable services together with their partners, and collaborating to create integrated new sustainable business technologies. Companies today are facing increasing complexity to execute profitably on continuous sustainable business transition towards circular economy. Responsible leadership is understood as a social-relational and ethical phenomenon, which occurs in social processes of interaction communication. This article will demonstrate that responsibility is not only the goal but also the means. It introduces a strategic concept, responsible business leadership, for utilizing responsibility as a business and innovation driver to facilitate the transition of industrial business towards the new service economy. Responsibility is creating significant impact and opportunities where business, technology and innovation intersect.

Digitalization is rapidly increasing and enterprises must find new ways to innovate for business advantage. Through digital transformation, the use of new technologies like cloud, mobile, big data, and social networks with increasing intelligence and automation enterprises can capitalize on new opportunities and optimize existing operations to achieve significant business improvement. The collection of enormous amount of scattered data, clustering it for analysis, visualizing it for decision making and using the selected data in new service development and execution is most important in the concept of responsible business leadership.

Häme University of Applied Sciences (HAMK) has a Smart Service-research center as dynamic breeding environment to create and execute, together with co-operation network, well-addressed research and development activities for regional and enterprise development needs. The research unit supports cross-sectorial

utilization of digital technologies and service business development. The objective is also to offer development support for municipal, industrial and commercial organizations by creating new opportunities and responding on business transition challenges. The management of responsibility in value network and entire society is becoming an important business driver. Most of companies, which are moving towards service business, need new concepts to manage life cycle business on the responsible way. Responsible business management and circular economy are key focus areas on the research strategy on Smart Service research center.

Most companies do not have a strategy or analysis on aligning business to responsibility. Being green to achieve mitigation, clean to reach up to optimization and smart to manage the transformation is the integrated, evolutionary approach. Responsibility is an opportunity integrator on the path. Integrating novelty with technology brings new opportunities for more responsible business models. The transformation towards responsible business takes a long time and that is why it is important to fully understand the strategic concept, identify the key issues and harness the associated opportunities. From initial compliance or carbon footprint thinking, steps can be taken which can concurrently be used to optimize enterprise-wide business processes and perhaps even begin creating strategic differentiation and offering enhancement. Knowledge is scattered and distributed in business networks. Competence areas have become more complicated and single human capacity cannot cope with all the needed competence to create new opportunities for businesses. Responsibility business leadership needs democratic innovation culture and co- innovation and co-evolution processes. This article introduces a concept of responsible business leadership and proposes how to analyze co-evolution over the life cycle of business transition by using Evolute, the intelligent web-based system for managing human experiences and organizational objects and capability in executing responsible business leadership.

2 Theoretical Background

A key element of the new approach is the revised legislative proposal on waste. This covers long-term recycling targets for municipal and packaging waste, measures to limit land usage, and incentives for Member States to use economic instruments at the national level [2]. It also aims to promote cooperation between industries, with waste from one process becoming secondary materials for others, through a simplified legal framework for by-products and end-of-waste status, creating more certainty for operators in these markets. Other measures promote waste prevention, particularly in relation to food.

Sustainability is no longer a question of if, but of when, and to what extent it will affect a specific business sector. It is no longer a negative reactionary tactic to moderate environmental climate change, but a positive proactive strategy to accelerate long-term business climate prosperity. It is not just about risk, reductions, and recycling, but an industry-changing paradigm integrating innovation, differentiation

and transformation. Antonio Tajani, EU Commission Vice President on Industry & Entrepreneurship stated, "there will be no sustainability without competitiveness, and there will be no long-lasting competitiveness without sustainability. And there will be neither of them without a quantum leap in innovation." Eppinger [4] has discovered that the link between sustainability and innovation is commonly mentioned, but not commonly made. Chesbrough [5] points out there are a new logic behind open innovation, which embraces external ideas and knowledge in conjunction with internal R&D. This offers a novel way of creating value. Miller and Langdon [6] introduce how to manage disruptive innovation by managing platform, product and process innovation in continuous cycles. Nidumolu et al. [7] explain widely why sustainability is now the key driver of innovation. Salminen [8] has discovered that when new value for the customer is created in the form of a product or service offering and it results in sustainable innovation, it is essential to know whether there is also a transition into a new business model of circular economy. At the same time, the business innovation must be built on the essential business structures (operational systems, contracts, network structures, competence, etc.). Tammela and Salminen [9] introduce the interoperability concept through which common innovation of sustainable products and services can be accelerated by an open semantic infrastructure. The open innovation process requires the definition of interoperability in order to achieve a critical level of network dynamics to create new products and services. Skyttner [10] introduces new systems theory with self-organization and evolution. Jamshid [11] introduces that system thinking is the art of simplifying complexity. It is about seeing through chaos, managing interdependency, and understanding choice. Concepts are important to explain chaos. Sanchez and Heene [12] have proposed an open systems model of firms. Improving of organizational competence also requires increasing managers' own cognitive flexibilities to imagine new strategic logics for creating and realizing new kinds of value-creating product offers and new ways of managing processes for creating and realizing new and existing product offers. Markopoulos and Vanharanta [13] have created the Company Democracy Model. It can be characterized as a multidisciplinary science, as it integrates many management (strategy, leadership, etc.), engineering (process knowledge, innovation), social (human resources, ethos, etc.), financial (marketing, extroversion, etc.) and other disciplines. The uniqueness of the model is its capability to integrate them all in a transparent way, making the execution sequence these disciplines to seem absolutely normal, reasonable and effective. The co-evolutionary spiral method in the model contributes towards the identification and achievement of the capacity, capability, competence, and maturity needed to turn knowledge into innovation. The model is structured in such a way that the method reflects the Co-Evolute methodology [14] and its application in organizational democratic performance. Evolute is an intelligent web-based system for managing human competences and organizational objects and capability in the world of business. Both organizational development methodologies (Co-Evolute and the Company Democracy Spiral Method) are directed towards the creation of an organizational knowledge based culture [15].

3 Research Questions and Research Approach

The role of circular economy as a business driver is growing in bio economy and industrial service business and has to be carefully taken into account in business transition. The opportunities of sustainability have not been understood in full context and as new service innovation. The main research questions are:

(a) What does circular economy mean in bio economy and industrial service business context?
(b) How to create business insight and business structures to support continuous innovation in circular economy?
(c) How to cope with the dramatically growing amount of data increased through digitalization? How this data can be used in optimizing value network operations and how to use it in the business transition by benefiting system approach?
(d) What type of circular economy business model and implementation process is needed in sustainable growth of business?

This chapter introduces a concept model for utilizing circular economy as a business and innovation driver to facilitate the transition towards the new Service Economy.

4 Multidisciplinary and Co-operative Environment

Digitalization changes everything and is a great opportunity to find out competitive advantage in business. Universities of applied science have a good opportunity and central role in supporting the growth of business on the area of circular economy.

The co-operation between government, enterprise and universities is essential to succeed in co-evolution when building up cumulative competence in creation of solutions for circular economy by benefiting digitalization in it. It is also essential to have a common vision to direct the local operation and funding. Otherwise, the activities can splinter as small pieces and do not form parts of the whole vision.

The development of business environments is understood to be the responsibility of public sector and government. Public sector is however multilayered (e.g. legislative-national-provincial-regional-municipal-areal). There are still other committees and operations, which have the duty to develop business environment. All the layers and activities should be along the same line, support each other and sustainable to get the co-operative environment to function efficiently. In rapidly changing operational environment, it requires clear and commonly understood vision. To describe the elements and layers, by which circular economy thinking has support, it is possible to draw a pyramid, Fig. 1. The layers describe the operations of the public sector, which support and enable effective and digitalized formation of circular economy.

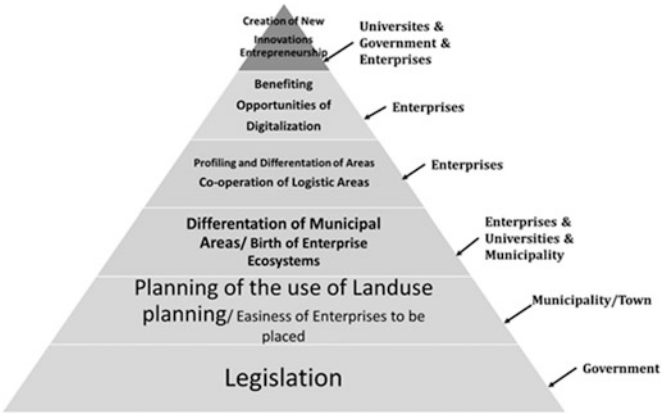


Fig. 1 Layered model of public sector enabling formation of circular economy

Legislation creates rules for the co-innovation and operations generated and new business opportunities (government). It is seen rather as enabler than restrictor. Planning of land use influences remarkably on settling and placing of enterprises and prerequisites for operation (e.g. logistics). Enterprises on the same value network can be placed on the same area to minimize logistics co-operation costs (government-provincial-layer). It creates also basis for sensible differentiation, birth of ecosystems and effective exploitation of lateral flow of material (government-municipality/city-layer). Industry and logistical areas differentiate principally according areal strengths. It is essential for success to have co-operation with other logistical areas. The key strengths of logistical areas are how they are connected to other logistic areas and how they bring added value to logistics area network. Logistic areas are not competing with each other. Logistic areas are not competing with each other. Differentiation and co-operation creates opportunities for benefiting of lateral flows and resource efficiency (material and energy efficiency). Digitalization and industrial internet can then be used when increasing the efficiency of processes. Industrial internet enables functional optimization of entire value network and increasing of use of material side flows (material and energy efficiency). It is possible to anticipate beforehand the disturbance situation of value network and their repair operations. Collected data from whole the value network can be used for its functional development or forecasting purposes. New entrepreneurship and new digital services can be created through digitalization activities. Industry 4.0 standard architecture can be applied for common framework, when starting business on circular economy.

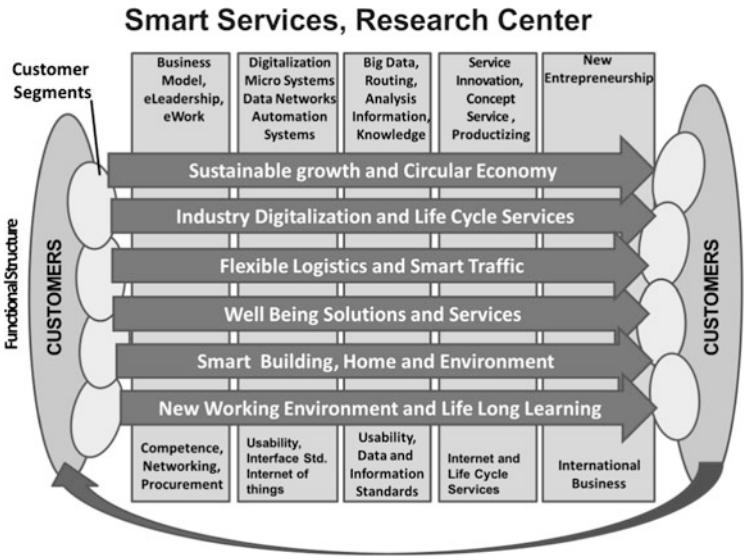


Fig. 2 Focus areas of the smart services research unit

Smart services research unit at Häme University of Applied Sciences supports industry, commerce and the society in digitalization and service development needs. The task of the research unit is to create and execute, together with co-operation network, well-addressed R&D activities for the region and its' enterprises. The Smart Services research unit supports the utilization of digital technologies and service business development across sectors: similar solutions can be adapted in various lines of business. The unit has six lines of business, Fig. 2.

Research center supports region's public and private sector partners on the creation and co-evolution on the business line Sustainable growth and Circular Economy, one of six business lines supported, Fig. 2.

The circular economy refers to an industrial economy that is restorative by intention; aims to rely on renewable energy; minimizes, tracks, and hopefully eliminates the use of toxic chemicals; and eradicates waste through careful design [2]. The system diagram in Fig. 3 illustrates the continuous flow of technical and biological materials through the value network.

The term goes beyond the mechanics of production and consumption of goods and services, in the areas that it seeks to redefine, (examples include rebuilding capital including social and natural, and the shift from consumer to user). The concept of the circular economy is grounded in the study of non-linear, particularly living systems [2]. This ensures enhanced flows of goods and services.

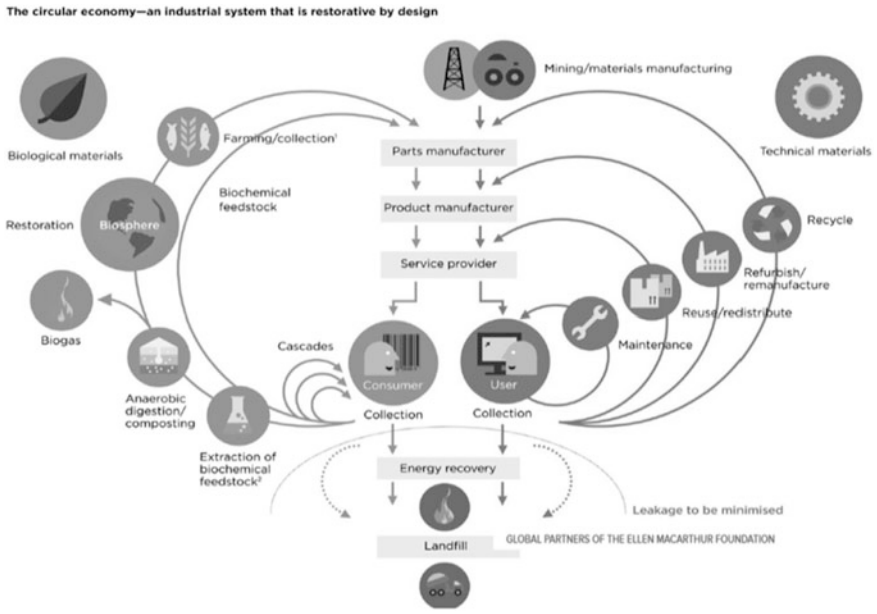


Fig. 3 The circular economy—an industrial system that is restorative by design [1]

5 Benefiting Digitalization and Big Data Supporting Business Co-evolution

The amount of scattered and structured data around us is increasing dramatically. It is a great business opportunity to benefit that data in business purposes. Circular economy with interrelated bio and mechanical cycle consists of huge amount of data. The data of waste from one partner means material for the other partner. Understanding the value proposition in growing value networks is essential. Management and analysis of data coming from various sources is routed through data-to-service process in business co-evolution of circular economy, Fig. 4. Creation and optimization of new operational functions and responsible business co-evolution requires democratic innovation and decision culture.

Intelligent web-based system Evolute is been planned to use at the analysis phase in the data-to-service-process over the transdisciplinary co-innovation and decision-making, Fig. 4. There will be several stakeholders of circular economy on the fields of bio economy and industry participating on decision-making and optimizing functionality of created new services.

In Fig. 5, there is an example of technology oriented competence and solution creation on the field of circular economy. It is essential to gather data from various sources and different processes. Automation system or sensor network (IoT) is creating data, which is gathered, clustered, analyzed and compare it with the data

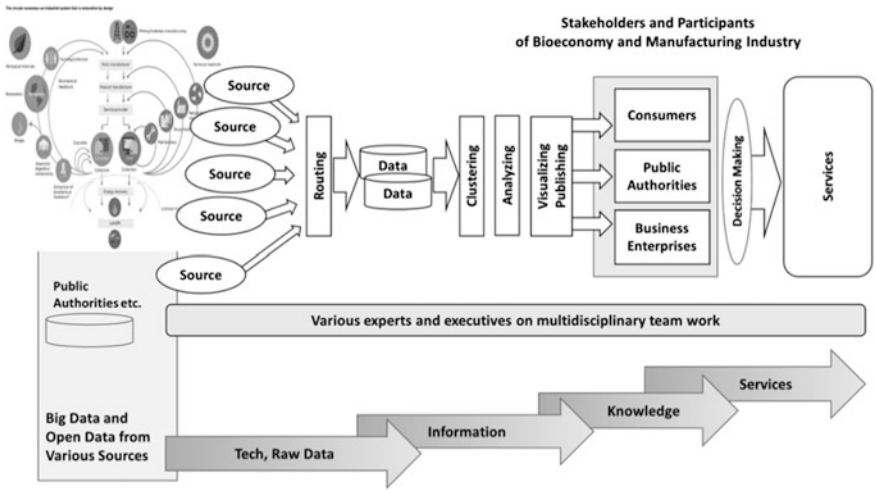


Fig. 4 From data to services process in business co-evolution of circular economy

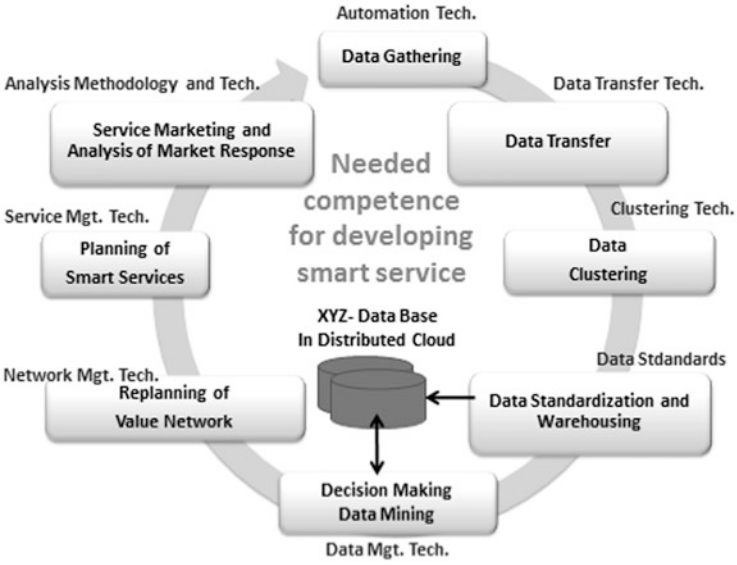


Fig. 5 Relationship of technology and competence in circular economy

gathered earlier and then make decisions on how the waste material should be reused, what type of logistics is transferring it and who should reuse and produce that. To support this value network process it is important to have all type of experts in virtual network optimizing material, logistic and reuse of material. There can also be final customer experts in the same network.

The substance in the network is knowledge and capability, which is activated when the customer requirements are decomposed. In order to manage economical and technical risks the new innovation should be evaluated as a value for customer and network partners. Effective method of decomposing the requirements reveals precisely. Content management competence, organizational capability and human mental capability are in strong interrelationship. It is planned to parameterize each of the entities and turn as a questionnaire's. Evolute-system is thought to gather and analyze the knowledge needed.

6 Circular Economy-Conceptual Model for Adaptive Development

Circular economy and industrial internet are rather new topics and there are few experiences on driving of benefit out of them both in enterprises and universities. That is why co-operation serves developing on collaborative way. Most of the innovations are created at customer interface and co-operative development on common platform, research and learning environment, is essential basis in succeeding on business co-evolution. Good co-operation requires management engagement, trust building, information, and experience delivering. It happens on various levels of operation; e.g. forecasting and roadmap-projects, applied research and development projects, on bachelor and masters' thesis works or creation of research and learning environment for experimentation and piloting. It is ought to be continuous on various organization levels. Co-operation and learning together on research and learning environment supplied by university is basis for new innovations and continuous development. Developing of superior competitive power through principals of circular economy is built by lean and digitalized value networks. It is important to succeed in benefiting multidisciplinary competence and open information sharing.

Sustainable growth and responsible business management is not possible to achieve by the way of linear economy but by circular economy [1]. Figure 6 describes the conceptual model of adaptive development towards circular economy by benefiting value chain management, proper digitalization and data analysis/management. The objective of circular economy is efficiency on the use of material and energy. The purpose of digitalization is to increase effectiveness on planning and optimization. The objective of using and managing value partners is to increase effectiveness of leadership and organization. The trend in succeeding on circular economy is that these functions will be continuously increasingly overlapping. The increasing digitalization and management on data-to-service-process are key enablers in business co-evolution.

Succeeding on circular economy co-innovation requires data-to-service management process and creation of adaptive multidisciplinary co-operation model for solution development. For research center to be capable to collaborate with

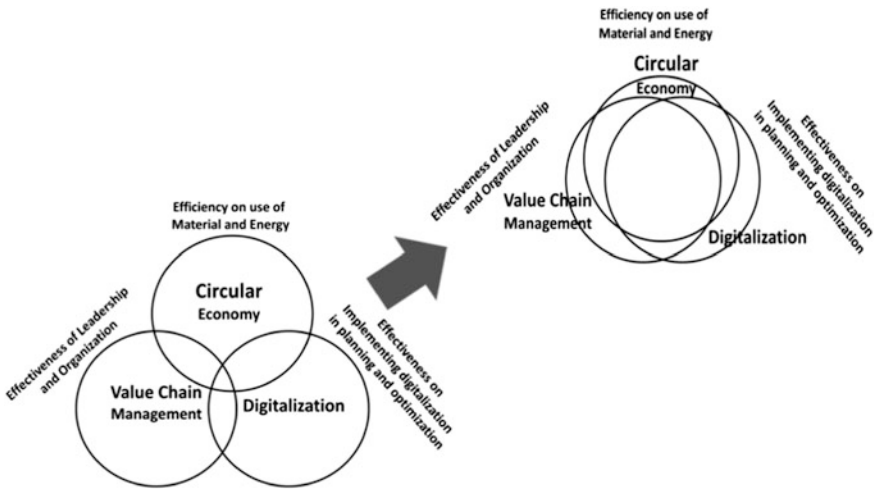


Fig. 6 Proper implementation leading on more intensive overlapping

industrial companies, it is important to know the overall capability of research and development unit. The experts making applied research with customers have to have content and process knowledge of customer site, they have to be capable to work in teams on distributed way with other experts in value network and have to certain collaborative skills to work together. In our article, we categorize the competence and capability on three layers: content management capability, organization capability and human competence and capability [16].

7 Discussion and Conclusions

Combining the principles of circular economy to value network thinking and digitalization of functionality of whole the network give opportunity for remarkable competitive advantage in business.

That requires combining of various theories but the main challenge is in utilization of transdisciplinary knowledge and implementation work. The use of new technologies; digitalization, big data, and social networks with increasing intelligence and automation enterprises can capitalize on new opportunities on and optimize existing operations to achieve significant business improvement on circular economy.

The paradigm shift in the effective circular economy is the alteration of purchase behavior from ownership and selling of machines to offering of services. Through that, development starts the increase of efficiency in supply network. Recognition of actual customer needs combined with life cycle calculation creates opportunities for life cycle services.

According the experiences of conceptual development work successful activity in circular economy is dependent on systematic long-term development on public sector. Essential topic is preparing of up to date legislation, which enables and controls the operation and creates business environment to apply new offering.

The important role for universities is to support enterprises by applied research and creation of research and learning environments for continuous piloting of new technologies and preparation of new business models on circular economy. Häme University of Applied Sciences supports the digitalization of bio cycle by Forssa facility, because it has long tradition on developing it. The focus on developing mechanical cycle is on the growth path of Finland, Helsinki-Hämeenlinna-Tampere, which is versatile area of industry. To be successful on new challenges of circular economy, enterprise-university partnership has to be tight and main objective is common learning. Long-term co-operation creates background for new co-innovation and business co-evolution.

European community is preparing new legislation and directives, which are speeding up the development of circular economy. Industry 4.0 as an industrial standard architecture has a remarkable role in preparing new functionalities on distributed value networks. The standard offers technical background and rules for implementation for digitalized circular economy.

Responsibility business leadership needs democratic innovation culture and co-innovation and co-evolution processes. This article introduces a concept of responsible business leadership. It also gives a concept on how to analyze co-evolution over the life cycle of business transition on circular economy by using Evolute for managing human opinions and experiences and organizational objects on public-private-relationship and capability in executing responsible business leadership.

References

1. World Economic Forum: Towards the Circular Economy: Accelerating the Scale-up Across Global Supply Chains. Switzerland, Geneva (2014)
2. European Commission (02.03.2016) https://kumu.io/ellenmacarthurfoundation/educational-resources#circular-economy-educational-resources/key-for-general-resources-map/intro-to-the-circular-economy
3. EU Environment: Taking Europe closer to the circular economy. Magazine Environment for Europeans, 06/01/2016 (2016)
4. Eppinger, S: How sustainability fuels design innovation. MIT Sloan Manag. Rev. Fall **52**(1) (2010)
5. Chesbrough, H.: Open Innovation: The New Imperative for Creating and Profiting from Technology. Harvard Business School Publishing Corporation, Boston (2003)
6. Miller, W., Langdon, M.: Fourth generation R&D: Managing Knowledge, Technology, and Innovation. Wiley, Canada (1999)
7. Nidumolu, R., Prahalad, C.K., Rangaswami, M.R.: Why sustainability is now the key driver of innovation. Harvard Business Review, September 2009 (2009)

8. Salminen, V.: Management of life cycle business transition by hybrid innovation. In: Managing Innovation in Connected World, ISPIM 08, 14–17.12.2008, Singapore (2008)
9. Tammela, J., Salminen, V.: Interoperability Concept Supporting Network Innovation. Information Technology Entrepreneurship and Innovation (chapter on a Book). Publisher Group Inc., Hershey (2007)
10. Skyttner, L.: General Systems Theory: Problems, Perspectives, Practices. World Scientific Publishing, Singapore (2005)
11. Jamshid, G.: System Thinking: Managing Chaos and Complexity. A Platform for Designing Business Architecture. Butterworth-Heinemann, Woburn, MA, USA (1999)
12. Sanchez, R.: Understanding competence-based management Identifying and managing five modes of competence. J. Bus. Res. **57**, 518–532 (2004)
13. Markopoulos, E, Vanharanta, H.: Human perception, interpretation, understanding and communication of company democracy. In: 14th International and interdisciplinary Conference of the Research Cooperation, Turku, Finland (2014)
14. Kantola, J., Vanharanta, H. and Karwowski, W.: The evolute system: a co-evolutionary human resource development methodology. In: Karwowski, W. (ed.) International Encyclopedia of Ergonomics and Human Factors, 2nd edn. CRC Press, Boca Raton, Florida, USA (2006)
15. Paajanen, P., Piirto, A., Kantola, J., Vanharanta, H.: FOLIUM—ontology for organizational knowledge creation. In: 10th World Multi-Conference on Systemics, Cybernetics and Informatics. Orlando, Florida, USA (2006)
16. Salminen, V., Kantola, J., Vanharanta, H.: Competence portfolio assessment of research and development center for regional development. In: 6th International Conference on Applied Human Factors and Ergonomics (AHFE 2015), Las Vegas, USA July 26–30, 2015 (2015)

Part XVIII
Essential Management Skills

Decisions

Johanna Suarez, Juan David Parra and Susana Valencia

Abstract Given the competitive nature of their jobs, it is not surprising that the majority of managers actively seek ways to strengthen its administrative capacity and ability to achieve effective performance. There are different reasons why there is so much interest in improving decision making at management levels, some relevant reasons are the quality and acceptability of decisions that could influence some aspects of career and personal satisfaction on managers. In this paper, we examine the influence of time pressure and time-dependent incentive schemes on the quality of decision-making in an experimental contest game.

Keywords Making decisions · Time pressure · Rationality · Game · Alternatives

1 Introduction

"High-velocity" environments are characterized by rapid changes in technology, demand, competitors, or regulatory rules [1] and often involve stress due to the need to make decision under time sensitive. As Eisenhardt notes, "the decision-making dilemma in such environments come from the fact that it is easy to make mistakes by deciding to soon and equally ineffective to delay choices or to imitate others".

The goal of any decision maker is to make the most optimal decisions possible with a minimal amount of cognitive strain or effort. This may not be a very frightening task when given unlimited time to assess the decision problem, but many situations exist that require individuals to make decisions under deadlines. What happens to decision making in the presence of either potential gains or losses when we are under time pressure? [2].

J. Suarez · J.D. Parra · S. Valencia (✉)
Universidad Nacional de Colombia, Bogotá, Colombia
e-mail: sumvalenciaro@unal.edu.co

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Research suggests three major ways in which people respond to decision problems under time pressure. First people accelerate their processing (i.e., spend less time processing each item of information) [3]. Second, processing tends to be more selective under time stress, focusing on the more important and/or negative information about alternatives [4]. Third, decision strategies may shift as a function of increased time pressure [5, 6].

We investigate decision making under situations where there is time pressure. We are interested in how people adapt their decision when faced with possible limits of time. Then we summarize an accuracy-effort framework for adaptive decision behavior and purpose a game to report a study of decision strategies based on that framework. Finally, we discuss the implications of the results for adaptive decision making under time pressure.

Our study explicitly aims to investigate these issues. In particular, we will address two research questions: (1) is there a tradeoff between the quality of decision-making and time pressure and (2) how do time-dependent incentive schemes affect the (possible) tradeoff between the quality of decision-making and time pressure?

2 Framework

2.1 Meaning of Decision

Decision means taking a position. It involves two or more alternatives under consideration and the person who decides will have to choose between them [7]. It is an action that needs to be taken when there is no more time to collect information [8]. How man behaves and acts to maximize or optimize a certain result; decisions are made in response to a problem. A problem is a discrepancy between the current state of things and the desired state which requires consideration of alternative courses of action [9].

2.2 Decision Making Definition

Decision making is the process of analysis and choice between alternatives, to determine a course of action [10]. Decision making is critical to the body and behavior of the organization. Decision making provides the ways to control and enables coherence within systems [7]. The decision making is the process of identifying and selecting a course of action, it is focused on the parameters of game theory and chaos [8].

Under these definitions made by the authors it can be concluded that decision-making is a process in which alternatives are defined for the solution of a problem, then they are analyzed and finally a decision is made.

2.3 The Decision-Making Process

The decision making process consists of 8 steps according Robbins [9]:

- Identifying problem
- Identifying decision criteria
- Weighting of criteria
- Development of alternatives
- Analysis of alternatives
- Select Alternative
- Implementation of alternative
- Evaluation of alternative

This process leads to a final and optimal decision when the problem is well identified and the goals are well defined. If these two statements lacks of a good definition and understanding, the whole process may result in a complete waste of time and decision making leads to disturbing and non-beneficial consequences.

Freman and Gilbert [11] also define the rational decision making process in four stages:

- Stage 1: Investigate the situation.
- Stage 2: Develop alternatives.
- Stage 3: Evaluate the alternatives and choose the best among those available.
- Stage 4: Implement the decision and monitor it.

This model is basic and similar to the one proposed by Robbins, but in a summarized way, so application of either is valid for making a decision.

2.4 Programmed Decisions

Decisions are made on a recurring basis to solve routine problems. For such decisions, problems are structured because they are simple easy to define and in such cases well known [9, 11].

2.5 Non-programmed Decisions

Decisions are made only once and provide specific solutions produced by an unstructured process. For these decisions, problems are unstructured, because they are new, unusual, ambiguous, and lack information [9, 11].

2.6 Conditions for Decision Making

When making decisions, it can find different conditions, which make the consequences of the alternatives difficult to predict or otherwise it has complete certainty about the expected results. These conditions classified the decision by their nature:

Uncertainty: Situation to make decisions where unpredictable external conditions exist or lacks of the necessary information to establish the probability of a certain event [11].
Risk: State to take decisions in which the probability of a given alternative would lead to a desired goal or result [11].
Certainty: Situation to make decisions on which information is accurate, reliable and results of different alternatives are measurable [11].

2.7 Rationality in Decision-Making

The amount of information that humans can handle is limited and often decisions must be subject to considerable pressure due to lack of time. The concepts of bounded rationality, conformity and heuristic explained these limitations and their perspective, letting achieve a great understanding of rational decision-making [9]. Bounded rationality explains why decisions are made under time restraints, inaccuracy of information, storage capacity and information processing [11]. Tversky-Kahneman and Gilbert-Freman, showed that in most people it is present heuristic principles or practical rules to support decision-making in an intuitive way [11], that are based on experiences, feelings and accumulated opinions [9].

2.8 Decision Making Under Pressure

Many decisions in economics and finance have to be made under severe time pressure. Furthermore, payoffs frequently depend on the speed of decision-making, as for instance, when buying and selling stocks. Interestingly, time-dependent payoffs under high time pressure lead to significantly quicker decision-making without reducing the quality of decisions [12].

One of the key sources of the presumed speed/accuracy tradeoff is that time pressure prevents a thorough and in-depth processing of information. This effect of time pressure can result in the so-called 'closing of the mind' [13] meaning that people seek cognitive closure and stop considering important aspects of multiple alternatives [12].

Evidence from psychological research on individual decision-making tasks suggests that a tight time constraint for decisions may impair the capacity for

information processing or the consistency of decision-making, thus reducing decision-making quality. It has been the purpose of several papers to investigate (1) whether time pressure has a negative effect on the quality of decision-making in an interactive context and, given an affirmative answer to the first question, (2) whether time-dependent incentive schemes have an effect on decision-making under time pressure [12].

Several experimental studies have pointed out that decision making under time pressure can reduce the accuracy of a decision, which is known as the speed-accuracy-tradeoff [14], produce extreme judgements and reduce the propensity to take risks [12]. Time pressure also seems to induce a more frequent use of heuristics in decision making [5]. Whether time pressure influences search behavior has not been studied thoroughly, though. Based on the results of previous research we expect that time pressure will influence search behavior in a way that decisions become less optimal [15].

Setting a tighter time limit for making decisions has been found to influence search behavior in initial rounds, i.e. when subjects are still inexperienced. This impact of time pressure in the early phase of the experiment is an important finding since it indicates that searching may be particularly suboptimal when subjects face a situation for the first time (think of an employee who suddenly loses his job and urgently needs to find a new source of income, which might induce him to accept the first opportunity of a new occupation, even if it is not an optimal one). The effects of tighter time restrictions on search behavior vanish quickly as subjects gain experience with the task, though. More experience leads in general also to quicker decisions [15].

An experiment is reported that investigated the extent to which affective state, information processing strategy and task structure determine the effects of time-pressure on decision making. Research participants were presented with risk scenarios involving a choice between safe and risky actions. The scenarios were systematically varied in terms of outcome valence (positive or negative) and effort associated with taking the safe action (high or low). Half the participants were given unlimited time to make their decision, the other half were required to choose within a deadline. The findings showed that time-pressured participants were more anxious and energetic and used a number of different strategies to cope with the deadline.

These effects, as well as changes in risk-taking, were shown to vary systematically with task structure, particularly the effort manipulation. The findings are discussed in terms of how they contribute to theories of time-pressure and the methodological implications they have for future research in this area.

Reviews of research on time-pressure have identified a number of ways in which the outcomes and processes underlying judgment and decision-making change when the time available is limited [14]. For instance, time-pressure has been shown to reduce the quality of decision making [5] induce less extreme judgements [16] and reduce the propensity to take risks [2].

Maule and Hockey [2] argued that the imposition of a deadline, the usual way of generating time pressure, may induce a number of different affective states depending, in part, upon the importance of the decision, and the extent to which

individuals appraise how they can adapt in ways that allow them to maintain their task goals at an acceptable level.

Second, Maule and Edland [17] argued that the effects of time-pressure may also vary with the mode of adapting used by individuals. They reviewed evidence indicating that time-pressured decision-makers may adapt in terms of relatively small scale or micro-changes in strategy. Examples of these include acceleration (increasing the speed or tempo or information processing) and filtration (increased selectivity of processing) [2].

As mentioned above, Busemeyer [18] demonstrated that the effects of time-pressure on risk-taking in a gambling task depend crucially upon the variance of probabilities and the positivity/negativity of the expected values of outcomes.

Our findings showed, as predicted, that in addition to feeling time-pressured participants choosing within a deadline were more anxious and more energetic. This provides strong evidence that deadlines induce not only feelings of time-pressure, but also broader changes in affective state. As indicated earlier, we believe that the increase in anxiety rejects an increased awareness of the need to work harder that occurs when the amount of time to make the decision is less than would normally be taken [2].

Our analysis of the effects of time-pressure on information-processing strategy revealed that, as predicted, participants used both filtration and acceleration to adapt to the imposition of the deadline. Unlike previous studies, we investigated the relations between the use of these different modes, and showed that these may be seen as, to some extent, complementary strategies for participants strong use of one is associated with less use of the other.

3 Game Design

For game design it was used the methodology described by Gomez [19]. This methodology consists of ten steps: (1) Identify the theme of the game, (2) State the purpose of the game, (3) Raising the Game instructional objectives, (4) Identify and define general concepts of the topic, (5) Select candidates techniques, (6) Select the technique or techniques most appropriate as characterization defined, (7) Include specific knowledge in the game, (8) Develop pilot sessions, (9) Consolidate the game and (10) Develop evaluation survey.

Below are detailed each one of the steps in the game design.

1. Identify the theme of the game.

   Decision making under pressure environments.

2. State the purpose of the game.

   (a) Teaching.

   - Understand the decision making as a rational process, paying particular attention to the evaluation of alternatives in light of the goals set.

- Establish differences between programmed and non-programmed decisions

(b) Check.

- The cost-type time pressures have been shown to reduce the quality of decision making [5], induces less extreme judgments [16] and reduces the risk acquisition [4].
- The preference of an individual to take a risk is inversely proportional to the magnitude of the undertaking, involving the decision.

(c) Measure

- Quantify the effectiveness of decision making under different environments at different pressure and risk.

3. State the instructional objectives of the game.

- Identify the participant's performance in situations of tension.
- Develop the participant's ability to encode information quickly and timely.
- Measure the quality and acceptability of decisions at different pressure environments (Time pressure).

4. Identify and define general concepts of the subject.

General concepts of decision making explained above in previous paragraphs.

5. Select candidate techniques:

Based on key words within the game theme, Instructional objectives and basic concepts and definitions.

The highlighted words in the topic are:

(a) Name of Theme: Decision making, pressure.
(b) Instructional Objective: Identify, pressure, decisions, information, level of participation, activities.
(c) Basic concepts and definition: Events, decisions, scenarios, random investment.

6. Select appropriate technique or techniques.

The evaluation of proposed techniques was based on the model proposed by Gomez [19].

In this model, several questions were raised for further techniques characterization (Techniques Knowledge Base available in Gomez [19] and Duque [20]). These questions can be differentiated or standard and both are scored weighted. The maximum score for each technique is calculated. Next step is evaluating each of the candidate techniques; their respective scores obtained are evaluated under the model criteria [19].

Table 1 Techniques evaluation

Evaluation techniques results	
Technique	Obtained score/total score [%]
Role play	68
Monopoly	62
Ladder	58

The results obtained for the chosen techniques are:

The results indicate that none of the techniques are within the range defined in the proposed evaluation criteria, meaning that those techniques does not fix with game proposal. A new technique needs to be arranged to meet the objectives of the game (Table 1).

7. Incorporate specific knowledge in the game.

In the previous step the techniques evaluated did not match to an existing technique template to modify it with specific knowledge of the game.

8. Pilot sessions of the game.

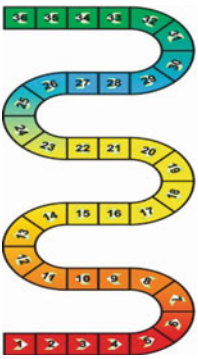
Three pilot sessions were executed for game testing. First session was applied to four players. The time fixed to each situation was 1 min. For the second session the number of players was two and time remains the same. For third session the participants were 2 and time was reduced to half a minute.

4 Consolidating the Game

From key point suggested in pilot sessions, there were some changes applied to game template and parts and materials of the game.

In Fig. 1, it is shown the final board design of the game with the respective modifications.

Fig. 1 Game board



5 Results and Conclusions

As a consequence of game application some values were tabulated in order to summarize the principal results.

The game was applied to 17 players distributed in four game boards as it follows:

- Game Board 1: Four players.
- Game Board 2: Four players.
- Game Board 3: Four players.
- Game Board 4: Five players.

The boards 1 and 2 had time restrictions; for game boards 3 and 4 there were no restrictions of any kind. The obtained results show that better scores occur in those game boards where there is not time pressure and consequently best decisions were made. Although there was no major difference between higher results this information is relevant to support what the objectives of the game are.

As shown in Fig. 2, the player number 5 of game board 4 (No restrictions game) is the higher score (34 points), 2 points before from the possible max point.

The player with lower score (25 points) was the player 4 of game board 1 (Restrictions game).

The average score for all players including restricted and no restricted boards was of 30 points.

In addition for those game boards with time restrictions the response time by alternative and player were measured. The time limit for each alternative as stated in the games was of 30 s, but in some cases players an-answered more quickly than the expected time limit possibly due to the complexity of.

Situations of the game and individual decision making process applied in the game.

First conclusion is that as seen in Fig. 2, time pressure influences the decisions made on boards 1 and 2 and can lead to take non-optimal or least favourable decisions. This could be seen on the left side of the graphic on Fig. 2. In the opposite case where no time restrictions were applied the results are better than those within time restrictions.

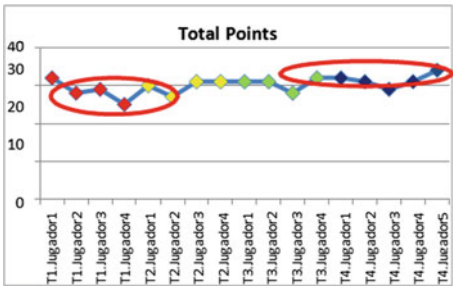


Fig. 2 Total points of game. Final session

A second conclusion that could be made is the time taken to answer the situations on the game; the lower and higher average time response could lead to a particular characterization of each alternative time limit, thus making the environment and conditions of the game more restrictive (Figs. 3, 4 and 5).

Referring to changes made on materials of the game (Board and cards), the modifications enhanced the experience of the game and were very helpful but there is the need to review again the organization of the cards in order to ensure a game environment that lacks of any type of constraints, focusing only on restrictions of time pressure.

Regarding the survey of the game, most of the people enjoyed the game and they think that it would be better to improve the cards where the sceneries are shown. They suggested the software design to play this game it would the best way to enjoy this kind challenger.

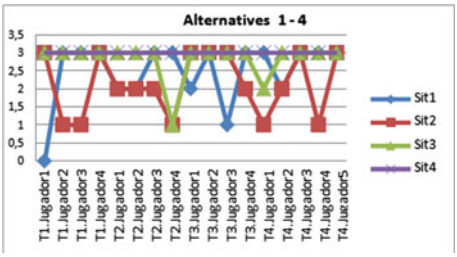


Fig. 3 Points per alternatives (1–4). Final session

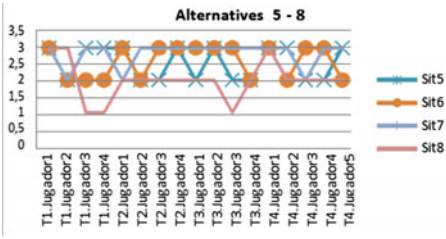


Fig. 4 Points per alternatives (5–8). Final session

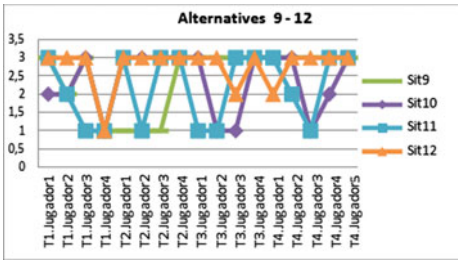


Fig. 5 Points per alternatives (9–12). Final session

For future work based on results and conclusions, the goal is to develop a computational game that could refine the behavior and performance of the game allowing a better achievement of instructional games objectives.

References

1. Eisenhardt, K.M.: Building theories from case study research. Acad. Manag. J. **14**(4), 532–550 (1989)
2. Maule, A.J., Hockey, G.R., Bdzola, L.: Effects of time-pressure on decision-making under uncertainty: changes in affective state and information processing strategy. Acta Psychol. (Amst) **104**(3), 283–301 (2000)
3. Huber, O., Kunz, U.: Time pressure in risky decision-making: effect on risk defusing. Psychol. Sci. **49**(4), 415–426 (2007)
4. Ben Zur, H., Breznitz, S.J.: The effect of time pressure on risky choice behavior. Acta Psychol. (Amst). **47**(2), 89–104 (1981)
5. Payne, J.W., Bettman, J.R., Johnson, E.J.: Adaptive strategy selection in decision making. J. Exp. Psychol. Learn. Mem. Cogn. **14**(3), 534–552 (1988)
6. Svenson, O., Edland, A., Slovic, P.: Choices and judgments of incompletely described decision alternatives under time pressure tle. Acta Psychol. (Amst) **75**(2), 153–169 (1990)
7. Kast, F.E., Rosenzweig, J.E.: Administración en las organizaciones, 1st edn. McGraw-Hill, México (1980)
8. Moody, P.E.: Decision Making: Methods for Better Decisions. Mc. GrawHill, New York (1983)
9. Robbins, S.P., Coulter, M.: Administración. Prentice Hall, México (2005)
10. Chiavenato, I.: Administracion En Los Nuevos Tiempos. McGraw-Hill (2002)
11. Stoner, J.A.F., Freeman, R.E., Gilbert, D.R.: Administración (1996)
12. Kocher, M.G., Sutter, M.: Time is money-Time pressure, incentives, and the quality of decision-making. J. Econ. Behav. Organ. **61**(3), 375–392 (2006)
13. Kruglanski, A.W., Freund, T.: The freezing and unfreezing of lay-inferences: effects on impressional primacy, ethnic stereotyping, and numerical anchoring. J. Exp. Soc. Psychol. **19** (5), 448–468 (1983)
14. Hockey, G.R.J., John Maule, A., Clough, P.J., Bdzola, L.: Effects of negative mood states on risk in everyday decision making. Cogn. Emot. **14**(6), 823–855 (2000)
15. Ibanez, M., Czermak, S., Sutter, M.: Searching for a better deal—on the influence of group decision making, time pressure and gender on search behavior. J. Econ. Psychol. **30**(1), 1–10 (2009)
16. Kaplan, M.F., Wanshula, L.T., Zanna, M.P.: Time pressure and information integration in social judgment. In: Time Pressure and Stress in Human Judgment and Decision Making (1993)
17. Maule, A.J., Edland, A.C.: The effects of time pressure on judgment and decision making. In: Decision Making: Cognitive Models and Explanation, pp. 198–204 (1997)
18. Busemeyer, J.R., Townsend, J.T.: Decision field theory: a dynamic-cognitive approach to decision making in an uncertain enviroment. Psychol. Rev. **100**(3), 432–459 (1993)
19. Gómez Álvarez, M.C.: Definición de un Método para el Diseño de Juegos Orientados Al Desarrollo de Habilidades Gerenciales como Estratégia de Entrenamiento Empresarial. Universidad Nacional de Colombia (2010)
20. Duque Reyes, D.C.: Diseño de un juego basado en experiencias como apoyo educativo para el desarrollo de la competencia trabajo en equipo Diseño de un juego basado en experiencias como apoyo educativo para el desarrollo de la competencia trabajo en equipo. Universidad Nacional de Colombia (2011)

Eficom, Game Designed for the Analysis of Effective and Efficient Communication Skills

Miguel Rojas, Maria Rojas and Katerine Villamizar

Abstract The process of transmitting ideas, information, emotions, feelings and attitudes in order to provoke a reaction on those who receive the message, is known as communication. Communication can lead to mistakes on how people of various occupations refer to other people in their inability to communicate in a right way, the lack of skills to listen presentations of their coworkers, or the unwillingness of subordinates to follow instructions. To solve this problem, this essay presents a design of a game called Eficom, which will strengthen and/or teach the foundations for an effective and efficient communication through a fun and recreational activity that involves the analysis of the fundamentals of communication.

Keywords Communication · Effective · Efficient · Skills · Work environment

1 Introduction

Interpersonal communication is the process of knowledge sharing between individuals. It's a component of organizational behavior in all levels [1]. This type of communication is essential to acquire employment, succeed at work, as well as being an effective manager. The communication is one of the most dominating activities in any workplace [2]. It is a two-way process, as it has to be sent and received. This could be why people with different occupations, have an inability to communicate well with others, a lack of skills to listen and understand their companions, or an unwillingness to follow instructions given by superiors.

Nowadays, organizations recognize the importance of effective and efficient communication, in the process of development at the organization, as in some cases

M. Rojas · M. Rojas (✉) · K. Villamizar
Universidad Nacional de Colombia, Sede Medellín, Carrera 80 no 65-223, Medellín, Colombia
e-mail: mafrojasva@unal.edu.co

M. Rojas
e-mail: mdrojas@unal.edu.co

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bottlenecks occur in the production process [3]. Different studies have attempted to provide models to isolate the important factors to understand and quantify or qualify the impact of different communication behaviors [4]. Therefore, knowledge of communication reinforces the organizational and competitive strategy, making "faster" processes, through organizational learning, which allows members to solve problems more effectively. Among the strategies of organizational learning, people centered strategies, such as groups of interdisciplinary work, conditioning gambling halls and experiments face to face based on experiences [5].

We present the design of a game that allows the strengthening and/or teaching of management skills for effective and efficient communication through a fun and recreational activity involving the analysis of the subject presented. The game is based on a method for designing games aimed at developing managerial skills and business training strategy [5].

Consequently, the following structure is used: in Sect. 2 the theoretical framework of concepts necessary for effective and efficient communication in an organization, in Sect. 3 the background is presented; Sect. 4 presents a detailed game design; Sect. 5 presents the analysis of the results found in the execution of the game; Sect. 5 shows conclusions and future work that can be derived from the method used for the design of the game, the theme of the game and their results.

2 Theoretical Framework

Communication is a process in which there is an allocation of common sense, simultaneous responses by all people in the current transaction and return messages are sent with circularity through numerous communication channels [6]. Any form of human communication is an attempt to create meaning, as long as it has a purpose.

Although communication is a complex process, for didactic purposes, the elements that comprise it are [7] (Fig. 1).



Fig. 1 Communication process

The point of view of communication as a transaction leads to three conclusions [4]. Firstly, the process is complex and dynamic. Transactions are contextual and therefore irreversible. They can be unique and unrepeatable. This can be interpreted as, communication based on a particular circumstance than once occurs, that set of events can-not be repeated identically.

Secondly, like a process, communication has no necessary beginning or end, so that the allocation of participants as transmitters and receivers is arbitrary, but sometimes useful. The role of issuer can be assigned in a given situation, but almost all organized communications occur in the context of ongoing activities, relationships and goals. Thirdly, all can be affected simultaneously and can affect any other member of the transaction. In other words, it sends and receives information at the same time.

Effective and efficient communication refers to the achievement of the objectives with minimum costs. For this, organizations prefer to use written communication that reaches all the employees, instead of face-to-face interactions with them. This translates to a reduction in time that benefits the economy of an organization.

One factor in the effective and efficient communication is what is encouraged in temporary work teams or in the environment of the relationship "vendor-customer". Verbal communication not only through letters, reports or written work, is accomplished by transmitting an effective message. Verbal communication, allows different actors be integrated; favor the study, analysis and research problems to them establish preventive measures.

3 Background

The different types of techniques used to teach the importance and fundamental concepts of effective communication are demonstrated of classic games, which are developed for this purpose, including "Telephone" [8]. "Telephone" is an activity where the moderator tells a story to one of the participants who repeat it quietly to the next person, continuing until they all have heard the story. The last person tells the group what they heard of the story and finally the moderator reads the original story to the whole group and then the following questions are asked. How close was the end of the story to the original story? How often does this happen in your organization? What can be done to ensure that everyone hears the same story?

Another games, is called "Back to Back" [9], it aims to make participants aware of the need of eye contact in interpersonal communication and discuss situations with the group as communication changes as participants move away each other. The same authors [8] defined another game called "Giants, Wizards and Elves" which is based on the classic game of "Rock-paper-scissors" to encourages communication and teamwork. Although the games above are fun, they do not fully achieve the goal of adequately teaching the basics of effective communication. For this reason we decided to create a hybrid game that uses various elements of each

game and take the best experience of each to achieve the goal proposed in a successful way.

4 Game Designed

Given the problems currently present in the communication process of organizations, a game is proposed following the methodology proposed by Maria Clara Gómez [5].

The game design is aimed at developing skills for effective and efficient management purposes and for business training that demonstrates management in areas of human communication. This game raises fundamental aspects to achieve a "good" communication, representing the barriers that are present in the active listening and feedback, among others.

4.1 Theme of the Game

Fundamentals of effective and efficient communication in the workplace.

4.2 Purpose of the Game

Teach and/or reinforce concepts of effective and efficient communication in the workplace.

4.3 Instructional Objectives of the Game

- Provide guidance on the basics of effective communication.
- Recognize the importance of effective and efficient communication to make better use of working time.
- Identify issues that interfere and prevent achieving effective and efficient communication.
- Identify strengths and opportunities, essential for improving the level of communication in the workplace.

4.4 Concepts of the Subject

The following outlines will describe some aspects of communication that will be taken into consideration for the execution of the game [10].

4.4.1 Communication

Communication is the integrated system that regulates behavior, maintains and makes relationships possible between beings. The act of communication is a complex process in which two or more people are involved. Through an exchange of messages with similar codes, those involved try to understand and influence each other so their objectives are accepted by using a channel that acts as support in the transmission of information [10].

4.4.2 Elements Involved in Communication

Although communication is a complex process, for educational purposes it can be broken down into the various elements that comprise it (Fig. 2).

4.4.3 Communication Process

The communication process involves the active and dynamic intervention of all the elements described above, creating an organized sequence in which all are involved to a greater or lesser degree and in one or more times of that sequence.

This process takes place in a specific context with a specific code, using at least one specific channel, with the intervention of transmitter and receiver, so the first transmits a message to the second.

First, the issuer must have clearly defined objectives, and from them, codify ideas, feelings or thoughts you want to convey, adapting them to the code is intended to be used, usually the language, to convey the message.

At the time of encoding the message, they have already activated the filters, or even earlier, when the issuer communication objectives arise. For the transmission

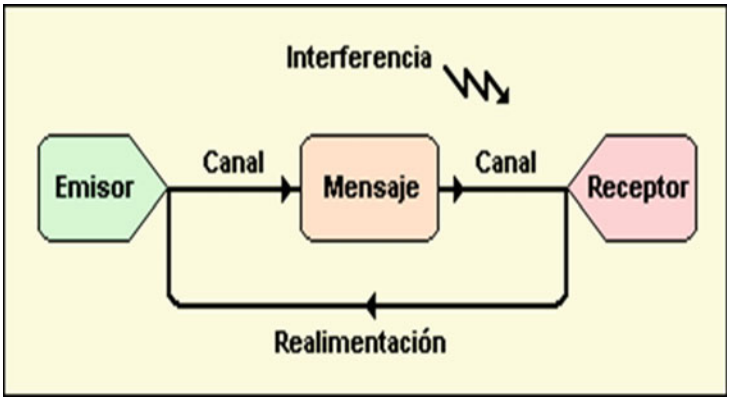


Fig. 2 Elements of communication

is used the channel deemed most appropriate by using a common code with the receiver in order to facilitate the communication. From the feedback that the receiver returns to the sender, it will be checked if you are using the appropriate code.

Once the message is transmitted, noises will enter the scene, making it difficult for the message to reach the recipient in the best conditions. The reception represents the arrival of the message to the receiver, and it may come with difficulties caused by noise.

The last step is the use of feedback, so that the receiver ensures that the content of the message that arrives is what the sender intended to transmit.

4.5 Attitudes that Favor Communication

When interacting with others, you need first to have attitudes that encourage communication, these can open our senses and prepare to "listen" and respond with the best or most appropriate of the following attitudes [10]:

- **Values-based Attitude**. Usually advises or provides answers referring to the values and duties, often orders are given.
- **Interpretative Attitude**. Tries to discover the true motives of the speaker's behavior. Sometimes it clarifies what happens to who communicates.
- **Exploratory Attitude**. In general adopt this attitude, when we need more data to standardize our approach and have a clearer idea of what happens or what the other person thinks or feels.
- **Consolatory Attitude**. Produce reassuring answers, trying to reduce distress or suffering.
- **Identification Attitude**. No offer solutions, but it is a friendly presence that provides safety and support to the other, and accompanies them on their concerns or suffering.
- **Emphatic and Comprehensive Attitude**. Respects the opinion of the other person, does not judge, and tries to capture the feelings behind the words of the speaker. Read between the lines.

Within the processes of effective communication, there are various elements of communication that should take into account certain characteristics:

- The transmitter must establish credibility, know the subject and know to who and how to deliver the message to avoid misunderstandings.
- The message must display intellectual components (language to help to understand and think) and emotional components (emotions and thoughts to explain the feelings about the message).
- The receptor must hear and understand the message to be able to respond effectively to the situation.

4.6 Technical Candidate

We will present keywords for the components of the game design as follow:

- **Name of the theme**. Communication, effective and efficient.
- **Instructional Objective**. Recognize, achieve and identify communication skills in the work environment.
- **Basic concepts and definition**. Attitude, representation, message, activities, effective and efficient.

By performing the analysis with keywords and techniques, it concludes that no candidate is coupled with our theme, because the percentages of acceptance of other techniques that could be candidates were below 50 %. However, a new technique was sought by reviewing keywords: Recognize, and identify the skills that were related to "tracking" (different tests for different teams where the first team to finish the tests, is the winner) the main objective of this is to recognize and identify the different skills of a particular topic, develop the skills of the players in relation to their team.

5 Conclusion the References Section

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Be aware of the fact that there are different aspects of business, finance, and marketing that have an impact on what we play in our fields. We must understand that many people think differently about how we do, and we must expose our ideas, which will help us communicate more effectively and do a better job, receiving criticism, and giving feedback to others.

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References

1. Weldy, T., Icenogle, M.: A managerial perspective: oral communication competency is most important for business students in the workplace jeanne D. Maes. J. Bus. Commun. **34**(1), 67–80 (1997). doi:10.1177/002194369703400104
2. Daniels, T.D., Spiker, B.K., Pope, M.: Perspectives On Organizational Communication, 4th edn. McGraw-Hill Humanities/Social Sciences/Languages (1996)
3. Stephen, P.B.: Communication structure and its effects on performance task, analytictech. http://www.analytictech.com/networks/commstruc.htm. Accessed 13 Jan 1997
4. Adler, R.B., II, R.F.P.: Looking Out, Looking, 12th edn. Wadsworth Publishing (2006)
5. Gomez, M.: Definition of a method for designing games aimed at developing managerial skills and business training strategy—A Institutional Repository, National University of Colombia, Medellin. http://www.bdigital.unal.edu.co/1968/. Accessed 21 Sept 2010
6. Berlo, D.K.: The Process of Communication: An Introduction to Theory and Practice, Holt, Rinehart and Winston (1963)
7. Schramm, W.L.: The Process and Effects of Mass Communication (Revised.), University of Illinois Pr (1971)
8. Flynn, B.: Communication, Family Nutrition Program. Ohio State University Extension (1995)
9. Martin, R.R., Weber, P.L., Lafontaine, K.R.: Back to back. Ohio State University Extension (1987)
10. Hofstadt, R.V. der.: The Book Communication Skills, 1st edn. Diaz de Santos (2005)

Levels of Trust in College Teachers

Miguel David Rojas López, Ludym Jaimes Carrillo and Stefania Fernández García

Abstract This chapter considers how trust becomes a key concept in higher education in a conceptual framework led by social capital. This research shows a way of measuring a qualitative variable as the confidence in quantitative terms, to find the current relationship between students of administration programs and related fields at the Universidad Nacional de Colombia that have 60 % or greater progress in their careers, and their teachers. Initially a survey was conducted to identify the trust in a relationship student-teacher to identify key aspects that are relevant for the education field. The information collected was analyzed through statistical methods, and based on the results of the research, students have an upper middle-generalized trust; however, looking for autonomous education, strategies should be implemented to improve these results, so that students are able to find a greater motivation and satisfaction to develop their knowledge.

Keywords Social capital · Trust · Human factors

1 Introduction

At the World Declaration on Higher Education in the 21st Century, the UNESCO (1998) claims that policies and strategies should be generated and implemented in higher education institutions, through which teachers gain the training that allows them to educate students as autonomous and independent persons with the ability to learn and take the initiative by themselves [1].

The current purpose is to transform information in knowledge in this kind of institutions, by means of acquiring reasoning, competences and values. Nevertheless, problems have been encountered with the strategies that are used to motivate students

M.D.R. López · S.F. García (✉)
Universidad Nacional de Colombia, sede Medellín, Colombia
e-mail: stfernandezga@unal.edu.co

L.J. Carrillo
Universidad Pontifica Bolivariana, Medellín, Colombia

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to train themselves academically in an independent way [2]. One of the feasible tools that could be used to improve these strategies, is the use of the "Social Capital" concept. Just as the economic capital makes the procurement of resources possible, the social capital allows to access efficiently to these resources by obtaining information through the members of social networks, which enables the reach of common goals [3].

The World Bank claims that "the Social Capital is the set of rules and bonds that allow social collective action. It is not only the sum of institutions that underpin a society, but the glue that joins them together" [4]. An essential element within this term is the trust, which allows to create stable relationships in order to reach goals in a collective way [5].

In recent years, the Universidad Nacional de Colombia has posed important challenges with respect to improving how engineering should be taught. A way to promote a solid basis for these improvements is to ensure a stable student-teacher relationship that encourages an autonomous knowledge ability and a sense of belonging to the University by the student, which facilitates the reach of previously set tasks and goals.

In the case of the Facultad de Minas of the Universidad Nacional de Colombia—Sede Medellín, the aim is to explain quantitatively the trust perceived by students of Industrial Engineering and Management Engineering, whose percentage of progress is equal to or greater than 60 % according to the Academic System of Information (SIA), by means of a survey, that is intended to identify the level of trust that students have towards their instructors. 209 surveys were filled, which provided the researchers with significant information, in order to model the general behavior of the population. The data analysis was made through the statistical software R, which allowed converting categorical variables into quantitative variables.

2 Theoretical Framework

The social capital is, from the viewpoint of sociology, a recent concept that is associated with the behavior of people as a community, i.e. it aims to explain the structure of social relations. For Coleman (1990), the social capital is based on the interpersonal bond within a social or organizational context, where relationships are encouraged on the basis of either planned or coincidental factors, in order to improve the affinity and closeness between people. These personal relationships are encountered within a social structure, that seeks to achieve determined interests [6].

At the end of the 20th century, the interdependence within societies starts to grow significantly, as a consequence of the fact that the achievement of an individual interest required the interaction between more than one individual, which linked the objectives of each individual with those of other members of the society [7]. This perspective of society was supported by Coleman, unlike other authors that argued an increasing individualism due to the classical economy that supported societies [8].

Authors like Putnam, define social capital as "… aspects of the organization such as trust, rules and networks, that can improve the efficiency of a society by facilitating a coordinated action" [9]. In this scope, trust is understood as a factor that contributes to the social capital, as it is considered as a key factor for the coordination between different agents that seek to achieve a common task, either organizational or social [10]. A great number of authors agree in the fact that trust facilitates cooperation between individuals of a society, i.e. trust and cooperation are factors that feedback each other positively, and thus if trust is achieved, cooperation between agents will be encouraged [11].

Putman differentiates two terms to identify two different categories of social capital: bonding and bridging. The first one, known as bonding social capital, consists in establishing equality relationships based on common interests and it makes "getting by" (as stated by Putman) possible. Bridging covers relationships based on respect, and therefore common interests are minimal; as stated by Putman, bridging allows "getting ahead" [9]. Furthermore, social capital has been conceptualized into two analytical categories: structural and cognitive. The structural component covers the mutual collective benefit that is obtained through the creation of social networks and roles within the society. The cognitive component consist of rules and values that people create through a collective action; among these rules and values are solidarity, trust and cooperation [11].

When reviewing the research of the last decade regarding social capital and the way this term has evolved and entered in several fields of social sciences, it becomes evident that it can no longer be understood as a simple concept, as it shows that human relationships can provide information, influence situations and create very efficiently, solidarity between the agents that create and compose a context [12]. That is why nowadays, social capital has been turned into a field of study that seeks to provide information and knowledge in order to get further means to understand human relationships.

3 Application

In order to determine the parameters of this study and to build the conceptual design of the survey, sociology concepts were needed, as terms like social capital and trust base their definitions on this field. In order to have a reliable questionnaire structure, it had to be designed in such a way that the answers reflected the actual credibility and trust towards teachers, which is why the emphasis was made in questions based on fraternal relationships and in values that encourage credibility, such as work experience, academic education and teaching methods.

The objective population of the study is composed by the students of Industrial Engineering and Management Engineering of the Facultad de Minas that, at the time the study is conducted, have a percentage of progress equal to or greater than 60 % according to the Academic System of Information (SIA) of the Universidad

Nacional de Colombia—Sede Medellín. The participations were based on a random sample method and executed online.

In order to decide the optimal sample size, the stratified random sampling method was used, as by nature, the behavior of students with a higher percentage of progress, typically diverges with respect to that of students with a lower percentage of progress. In a stratified random sample, the population is divided in groups of lower size, such that the desired features are uniform within each group, but differ from one group to another. This division allows the analysis to be performed in a more coherent fashion. For this study, the calculation of the simple size was made with the following expression [13]:

$$n = \frac{\frac{\sum_{i=1}^{L} N_i^2 P_i(1-P_i)}{W_i}}{N^2 \frac{B^2}{Z_{\alpha/2}^2} + \sum_{i=1}^{L} N_i P_i (1 - P_i)}$$

where:

L Number of the stratum

N_i Total number of observations in each stratum i

N Size of the entire population

W_i Weight of the stratum i, which is equal to the size of each stratum i, divided by the size of the entire population, and its value lies between 0 and 1.

The confidence level was taken as 95 % and the established estimation error was 0.05. The method of proportions (P_i) was applied in order to find the optimal sample size, as the variance of the students in the sample was not accessible. For all the stratums, a value of 0.5 for P was used, as it is the greatest possible value for the answers of the nominal categorical variables. The groups for the stratification are:

- Stratum 1: Students with a percentage of progress between [60–70) %.
- Stratum 2: Students with a percentage of progress between [70–80) %.
- Stratum 3: Students with a percentage of progress between [80–90) %.
- Stratum 4: Students with a percentage of progress between [90–99] %.

Based on the above, the optimal sample size was calculated for the entire population, so as to find the amount of students to include in the sample for each stratum (Table 1).

Table 1 Total sample size and by stratum

Stratum	% Progress	Total
1	[60–70)	56
2	[70–80)	47
3	[80–90)	45
4	[90–99]	61
Total		209

Two answer options were used for the questions, based on the Likert scale:

- Very unimportant, unimportant, somewhat unimportant, neither important nor unimportant, somewhat important, important and very important.
- Never, almost never, sometimes, indifferent, often, almost always and always.

An increasing percentage scale was assigned to both answering options: 14, 29, 43, 57, 71, 86 and 100 %. These percentages were calculated dividing the numerical value of the chosen answer by the total number of possible answers (seven). Based on these numbers, the trust generated by each variable or question was calculated, which is equivalent to the arithmetic sum of the percentages of each category of interest; the same weight is assigned to each one of them.

Statistical techniques for categorical data were implemented in order to measure each one of the variables of interest, such as contingency tables with count-crossed classification. Moreover, a correlation analysis was made in order to determine whether the relation between two variables is direct or inverse, i.e. if their behavior is similar or opposite. The correlation coefficient can take values between −1 and 1, where values close to 1 indicate a similar behavior of the two variables, i.e. a dependence relation; values close to −1 indicate an opposite behavior of the variables; and values close to 0 indicate an indifferent relation between the variables.

4 Results and Conclusions

For the purpose of this study, the calculation of the average trust by stratum and for the entire population, was carried out by quantifying the percent measure of the average trust, due to the fact that the set of questions selected for the survey describe coherently the meaning of this term, showing unconsciously what the participant actually think and feel. This is why the result of each person, weighted uniformly results in the trust of each stratum.

In Table 2, the average trust of each stratum is shown. It is observed that the trust perceived by the students towards their teachers decreases throughout their studies. The average trust in the first stratum is 79, 20 %, and in the fourth stratum it decreases to 77, 45 %.

Although a decreasing trend is observed, the behavior between one stratum and another does not differ significantly. Nevertheless, this decrease in trust level can be consequence of the increasing critical attitude of students towards their education,

Table 2 Average trust

Stratum	Average trust
1	0.792
2	0.7819
3	0.7778
4	0.7745
Overall average trust	0.7815

as they progress with their studies, because they are closer to confront themselves with work life, and therefore expect and demand more credibility from their instructors. Furthermore, as students progress with their studies, they question the selection of qualified teachers, as methods like the survey students take to grade them, are not taken properly into account for the academic improvement of the university.

The following Table 3 shows the linear correlation coefficient between the variables that were selected for the research.

The use of other languages has the highest correlation degree with a master being the highest education level of the teacher, as it is common to follow this level of studies abroad, which leads to a higher credibility of the teacher. Moreover, mastering more than one language is currently a key factor to stand out in work life, which lead students with a high percentage of progress to look for teachers that stress this kind of knowledge.

Voluntary attendance of students to class has the highest correlation degree with objective evaluations and with the confidence while lecturing. Objective evaluations are understood as those in which the teacher actually evaluates the topics covered in class, and in which grading is based on objective criteria, i.e. open questions where the student's opinion may differ from that of the teacher are avoided. Besides that, the objectiveness while grading encourages students to go to class, and to feel comfortable with doing so, which consequently leads them to use the other academic spaces that are offered by the institution and by teachers, like consultancies or tutoring. With respect to the confidence while lecturing, students usually associate this feature with knowledge and with the skill required to teach the course, which therefore creates an image of the instructor that supports his/her academic level and motivates the voluntary attendance to class.

Most students prefer methods where some interaction between them and the teacher, and where the class is supported with visual aids, are evidenced. This kind of method, known as interactive conference, serves as a tool to transmit knowledge, and ultimately, to establish a dialog with the students; besides that, it allows students to feel as part of the educational process, where the teacher takes suggestions and perceived ideas into account. A useful tool to create dialog in class, is to assign previous reading material, so that critical and responsible thinking is encouraged in the student population; similarly, the teaching method can be supported with presentations from the students, but avoiding making this the common overview of the course, as teaching methods based only on student presentations relied within the less desired according to the study.

Besides the methodology employed to teach the class, the results of the study show that students have a remarkable interest in associating the covered topics with the evolution of industry, as this could make a significant difference in their future work life. A problem perceived by the student population, is that most courses have a strong theoretical foundation, but are weak concerning the practical component, which leads to an academic and professional disadvantage in the future. The Facultad de Minas has currently enough tools to encourage and promote more regular practice sessions in courses related with the two programs involved in this

Table 3 Linear correlation matrix

		(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)
Specialization	(1)	1	–	–	–	–	–	–	–	–	–	–
Respectful attitude	(2)	0.12	1	–	–	–	–	–	–	–	–	–
Master	(3)	0.39	0.18	1	–	–	–	–	–	–	–	–
Doctorate	(4)	−0.12	0.1	0.41	1	–	–	–	–	–	–	–
Use of other languages	(5)	0.06	0.09	0.25	0.14	1	–	–	–	–	–	–
Compulsory attendance	(6)	0.04	−0.09	0.03	−0.09	0.08	1	–	–	–	–	–
Voluntary attendance	(7)	0.1	0.14	0.08	0.11	0.07	−0.29	1	–	–	–	–
Objective evaluation	(8)	0.11	0	0.14	0.1	0.01	−0.15	0.23	1	–	–	–
Confidence while lecturing	(9)	0.14	0.09	0.07	−0.02	−0.14	−0.16	0.29	0.35	1	–	–
Responsibility and punctuality	(10)	0.02	0.13	0.21	0.01	0.03	0	−0.01	0.13	0.04	1	–
Subjective evaluation	(11)	−0.09	0.04	0.01	0.04	0.04	0.12	−0.16	−0.43	−0.32	−0.01	1

study, and therefore this kind of knowledge should be intensified as part of the course schedule for most courses.

Students associate part of the qualification of the teachers with their disposition to listen and attend respectfully any suggestions regarding the methodology or the topics covered in the course. A nice and formal attitude from the teacher is an incentive to inspire more trust and respect in his/her students. According to the results, students have a greater disposition to learn when they have a personal relationship with the teacher, i.e. the image that the students have of the teacher affects significantly the attendance and learning degree.

A key conclusion of the study is that the perceived trust is higher when the teacher has had work experience, as it allows them to complement the theory with practice, and students may see themselves reflected in these work experiences. Furthermore, their experience may work as a proof that the knowledge acquired throughout college studies has indeed application in their future work lives, which can improve academic performance of students because of the trust towards the teacher.

In academy, it is common to find students consulting their colleagues, about whether or not a certain course is being well taught by the teacher that is currently in charge of it; this kind of research, which is carried out before taking the courses, show that the image provided by the teacher is a key factor to students to select their classes. It is here where the survey that students take on the performance of their teachers gains importance, as it serves as a bridge between the administrative staff and the student population. It is therefore vital that these comments are taken into account, and that they promote changes in the different methodologies and attitudes that teachers have towards their students.

Overall, the trust perceived by students in this study towards their teachers is high; nonetheless, strategies should be implemented in order to promote a stable student-teacher relationship, and consequently to create strong foundations that allow reaching common goals of the faculty.

References

1. Bermúdez Bonilla, L.A.: La construcción de la confianza en la relación estudiante-docente en la Facultad de Admisnitración en la Universidad de Colombia, sede Manizales (2011)
2. Yáñez Gallardo, R., Pérez Villalobo, V., Yáñez Gallardo, C.: La confiabilidad hacia los docentes por parte de los estudiantes y su influencia en la construcción de confianza y en la identificación organizacional hacia sus carreras. Estud. pedagógicos **31**(2), 89–103 (2005)
3. Krasny, M.E., Kalbacker, L., Stedman, R.C., Russ, A.: Measuring social capital among youth: applications in environmental education. Environ. Educ. Res. **21**(1), 1–23 (2013)
4. Rojas López, M.D., Marin, S.P.: Aproximaciones a la medición de confianza. Dyna **73**(150), 119–130 (2006)
5. Yáñez Gallardo, R., Pérez Villalobos, M.V., Díaz Mujica, A., Neira Troncoso, D.: La confianza como determinante de la actitud de los estudiantes universitarios hacia la encuesta de evaluación del desempeño de sus docentes. Interam. J. Psychol. **39**(3), 375–382 (2005)

6. Rojas López, M.D., Pérez Ortega, G.: Capital social: en las universidades píblicas de Medellín. Medellín, Colombia: Universidad Nacional de Colombia, sede Medellín (2006)
7. Portes, A.: Social capital: its origins and applications in modern sociology. Annu. Rev. Sociol. **24**(1), 1–24 (1998)
8. Zapata, C.M., Rojas L., M.D., Gómez A., M.C.: Modelado de la relación de confianza. Educ. y Educ. **13**(1), 77–90 (2010)
9. Urteaga, E.: La teoría del capital de Robert Putnam: Originalidad y carencias. Reflexión Política **15**(29), 44–60 (2013)
10. Saiz, J., Jiménez, S.: Capital social: una revisión del concepto. Rev. CIFE **1**(13), 250–263 (2008)
11. Seferiadis, A.A., Cummings, S., Zweekhorst, M., Bunders, J.: Producing social capital as a development strategy: implications at the micro-level. Prog. Dev. Stud. **2**, 170–185 (2015)
12. Kwon, S., Adler, P.S.: Social capital: maturation of a field. Acad. Manag. Rev. **39**(4), 412–422 (2014)
13. Correa Morales, J.C.: Análisis de datos categóricos, 1st ed. Universidad Nacional de Colombia, sede Medellín (2009)

Human Resource Management and Organizational Behavior

Cooperation to Make Networks Study Case, Net-Box Game

Miguel David Rojas López, Maria Elena Valencia Corrales and Samuel David Rojas Valencia

Abstract Social networks are constantly built in organizations who work in the studio or in coexistence with other individuals. Cooperation between different entities is generated through networks whose goal is to exchange information, improve performance and optimize resources. The game called Net-Box shows how networks are built from similarities and the cooperation emerges as a structure, allowing a common goal. The software UCINET, is constructed from data collected in playing sessions applied at the Nacional University of Colombia, Medellin. Finally, the results are presented and the conclusions on the structure of the networks are documented.

Keywords Social networks · Cooperation · Games · Interdisciplinary · Ucinet

1 Introduction

Currently, organizations adapt to the environment influenced by Information and Communication Technologies—TIC's—(Tecnología, información y comunicación, by its Spanish acronym). According to the particular interest of each one and their preferences, networks are groups with a defined objective form. These social networks are structured in different stages over time, achieving strengthens links between different nodes.

M.D.R. López · S.D.R. Valencia (✉)
National University of Colombia Medellin, Medellin, Colombia
e-mail: sdrojasv@unal.edu.co

M.D.R. López
e-mail: mdrojas@unal.edu.co

M.E.V. Corrales
Fundación Universitaria Luis Amigo, Bogota, Colombia
e-mail: Maria.valenciaco@amigo.edu.co

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With the methodology of [1] it is created the Net-Box game where participants form a network in four stages according to the different characteristics and is designed with given instructions.

The information collected called Ucinet, feeds the software and it initially generates a graphic with information showing the result of the network built.

2 Conceptual Framework

2.1 Social Networks

In 1954 the anthropologists J.A. Barnes use for first time the term social network, to describe the relationships between the Norwegian fishing of a village. Kadushin [2], define a network as a set of relationships. More formally a network is composed of nodes in mathematical terms and a description of the relationship between them. The relationship between nodes can be unidirectional, where it does not exist a feedback or is bidirectional, where both nodes receive feedback information. A node is an object that makes up the network. Interaction between nodes is usually represented by a graphic. In Fig. 1 the graph with 3 nodes and one- and bidirectional relationships observed.

As is expressed by Benito Zafrilla [3] complex networks are presented in all parts of nature, society and biology, neurology, communications and computing. In Fig. 2 the present relationship between complex networks and social networks is shown, which include human behavior, while the other networks is absent.

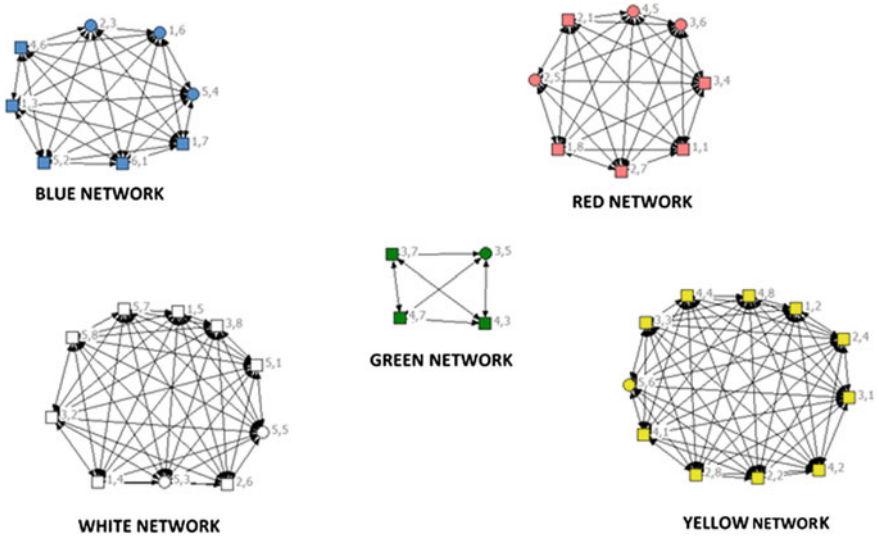


Fig. 1 Graphic

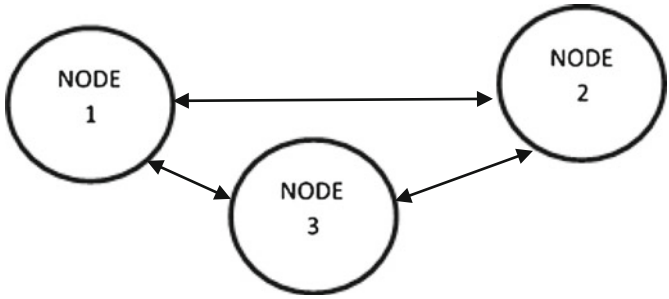


Fig. 2 Relation of complex networks—Social

Social networks are defined as a set of actors-individuals, groups, organizations, communities, global companies, among others. Linked with each other by a relationship or set of social relations [4]. An essential feature for the formation of a network is raised by Madrid [5], explaining that social actors form a line to the similarity of their objectives, projects or sympathies network. Currently, the social network analysis acquires a significant role in theories concerning the creation and distribution of information by individuals within the organization that builds the network [6].

2.2 Compete, Collaborate and Cooperate

The steps for building networks can start competing. Johnson and Johnson [7] speak of two key types of competition; constructive and destructive. In constructive competition winners care about learning from the losers, ensuring that they have more knowledge before competing. Destructive competition wins in self-interest above seek mutual learning between the parties.

Then, it is expected that the parties evolve to collaboration. According Gros and Adrian [8], collaboration is a process of constant interaction in problem solving, project development or discussion about a particular topic; where each participant has defined the role in achieving shared learning, and where the counselor involved as a mediator, ensuring the effectiveness of collaborative activity.

In conclusion, the parties understand, that to achieve the objectives Guitert and Gimenez [9], cooperation is necessary, argue that performs cooperative learning when a reciprocity between a group of individuals who can differentiate and contrast their views given such so they come to generate a process of knowledge construction. It is a process in which each individual learns more in a group than what he would learn by itself, the result of the interaction of team members.

In Fig. 3 is shown as the first step in a relationship is competition, and then appear interactions initiating the collaborative process and evolves with multiple interactions toward cooperation.

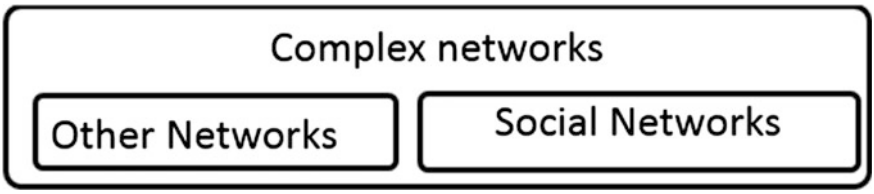


Fig. 3 Compete, collaborate, and cooperate

Table 1 Shows the steps of the methodology

Steps	Description
1	Identify the topic of the game
2	Establish the porpoise of the game
3	Set the goals of the game
4	Identify y define the general concepts of the topic
5	Select the applicant techniques
6	Select the proper technique, in base of the character of the game
7	Incorporate the specific knowledge of the game
8	Develop pilot sessions of the game
9	Develop the final version of the game
10	Elaborate a survey to evaluate the game

3 Game Design Net-Box

From the methodology proposed by Gomez [1], the game design Net-Box was performed.

Table 1 Metodology for the design of the game.

The game aims to structure social networks showing the aforementioned steps in building networks; competition, collaboration and cooperation.

To teach the process of building networks, the first step is that each individual selects a square of colored paper, which in this case is the common theme that has. Follow by the instructions given proposed, an individual activity, then in pairs and then connect four players finally able to build a network of 8 participants where all have something in common.

Networks are structured according to the color distribution where each participant is an element according to the instructions given, which is part of a complementary module to another and this in turn is part of a larger element.

4 Results

Table 2 shows the location of each color of the participants of the pilot test conducted at the Facultad de Minas.

Table 2 Color location

	1	2	3	4	5	6	7	8
1	r	a	z	b	b	z	z	r
2	r	a	z	a	r	b	r	a
3	a	b	a	r	v	r	v	b
4	a	a	v	a	r	z	v	a
5	b	z	b	z	b	a	b	b
6	z							

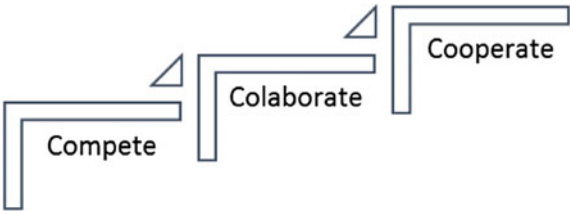


Fig. 4 Networks representation made by UCINET

Figure 4 shows the networks built by the UCINET program with binary information provided by the Excel.

Each network is constructed with nodes of each color, blue nodes (z) are attached on the stages, and in the graphic the coordinated location is reordered.

5 Conclusions

- The selection of random color is what defines the structure of the network which can affect the results, causing a large network such as yellow and one with few nodes as the green one.
- Initially, in the first instruction, each individual built the box assuming compete against others, but after the second round, it understood that should work together to collaborate and further cooperate.
- The players understood that if they did not work properly in the first stage, the interaction with the other built elements generate problems in the joint network, which led to an ongoing review of the structure of the box.
- Initially, the gender factor did not affect the consolidation of the network, because it was not a stated objective in the game.

References

1. Gómez Álvarez, M.C.: Definición de un Método para el Diseño de Juegos Orientados Al Desarrollo de Habilidades Gerenciales como Estratégia de Entrenamiento Empresarial. Universidad Nacional de Colombia (2010)
2. Kadushin, C.: Introduction to social network theory. Networks **63**, 60 (2004)
3. Benito Zafrilla, R.M., Cárdenas Villalobos, J.P., Mouronte López, M.L.: Redes Complejas: Elnuevo paradigma (2007)
4. Lozares Colina, C.: La teoría de redes sociales. Pap. Rrevista Sociol. **48**, 103–126 (1996)
5. Madrid, E.P.: Las redes de conocimiento y las organizaciones. Rev. Bibl. y Tecnol. la Inf. **2**, 23 (2005)
6. Pacheco, M., Antonio, L.: Redes sociales y Gestión de la Información: un enfoque desde la teoría de grafos. Ciencias la Inf. **43**(1), 29–37 (2012)
7. Johnson, D.W., Johnson, R.T.: The impact of cooperative, competitive, and individualistic learning environments on achievement (2013)
8. Gros, B., Adrían, M.: Estudio sobre el uso de los foros virtuales para favorecer las actividades colaborativas en la enseñanza superior (2004). http://campus.usal.es/teoriaeducacion/rev_numero_05/n5_art_gros_adrian.htm
9. Montse Guitert y Maria Pérez-Mateo.: La colaboración en la red: hacia una definición de aprendizaje colaborativo en entornos virtuales. Teoría la Educ. Educ. y Cult. en la Soc. la Inf. **14** (1), 10–31 (2013)

Communication Patterns

Miguel Rojas, Alexander Correa and Mariana Henao

Abstract Several studies have been made about of communication patterns; Alex Bavelas is one of the first researchers in this field. He developed a study based on a game and an analytical method, finding interesting results related to the communication process. Given the importance of the topic, this paper seeks to analyze the communication process, basing it on Bavelas' work but using tools such as experiment designs, aimed to extend the results to the engineering field.

Keywords Confidence · Communication-structures · Level of information complexity · Bavelas' game

1 Introduction

An organization's principal objective is to guarantee a confident, efficient and effective performance. In order to achieve this, each organization has specific tools; one of these, without doubt, is the communication process and its proper management.

When a particular activity needs to be done by a group rather than a single person, it has been observed that groups tend to conform to patterns of communication that allow the most rapid and successful flow of ideas, information and decisions. Before taking the risk of lose something important and be depending of exploitation of the vulnerability by somebody who already got the information, people who going to give information to somebody, must be willing to be vulnerable to the confidence to be useful [1, 2].

In groups free of external control, the interaction patterns that emerge and stabilize the social product of the process are there within the group. However, the group that exists as part of a larger organization is seldom free to make such an adjustment. Most organizations consider that it is important to express the com-

M. Rojas · A. Correa · M. Henao (✉)
Universidad Nacional de Colombia, Bogotá, Colombia
e-mail: mahenaogr@unal.edu.co

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munication pattern in order to work towards effectiveness [3]. For this kind of groups (free of external control) the confidence could be classified as thickness confidence or generalized which is confidence in people in general; and thick or particularized confidence which emerges between people who have ties narrow [4].

As Borgatti [5] says, the organizational chart of a bureaucratic organization can be thought of as a network which represents a social relation that tends to channel a lot of the communication within an organization. Different kinds of information flow through the communication process, such as prescriptive information (do this, stop doing that) that flows downward along the links, while descriptive information ('this is the status of such-and-such project') flows up the links, often in the form of reports or presentations. The organization also determines a lot of other communication as well; most roles (jobs) within an organization are interlinked, forcing occupants of those roles to interact with others playing their own roles.

In this way, other studies about this issue affirm "the organizations exist in the interpretative process of its members" this statement shows the important role that communication plays in organizational development. Taking this into account and given that there are many ways to coordinate an organization, the question arises of how the pattern of communications within the organization affects the performance of the organization [5].

Focusing on this question, Bavelas [6] and his student Harold Leavitt at the Massachusetts Institute of Technology (MIT) developed an investigation in the late 1940s and 50s, seeking to determine if it makes any difference who may communicate with whom. This study is embodied in the paper "Communication Patterns in Problem-solving Groups."

In order to study these approaches from a scientific perspective, through a formal statistical model that validates the results, the analysis was done based on experiment design theory. This study aims to find out if the type of structure and the level of information complexity, each separately, have an influence on the success of the communication, and whether or not there is a significant interaction between these.

2 Bavelas's Game

Bavelas [6] and his student Harold Leavitt developed an experiment applying a game that consists in each member of an established group of five people receiving one of the five cards for each group. Each of those cards has five symbols, arranged so that each symbol appears on four of the five cards, but only one symbol appears on all five cards. The game participants are instructed to identify which symbol is found on all five cards, with the aim being to accomplish this task as quickly and efficiently as possible. In order to communicate with each other, the players have to use written messages and follow a previously assigned structure. The game designers proposed four communication structures, as presented in Fig. 1, intended to analyze some potential significant effect on the communication process.

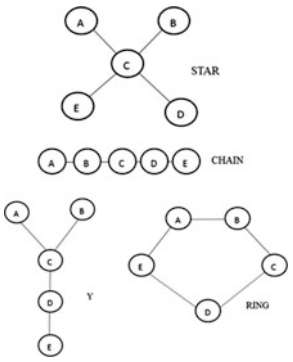


Fig. 1 Communication structures. *Source* Cartwright y Zander, 1958 [7]

This effect is analyzed; they studied the structure based on "distance," defined as the distance between the members positions according to the structure assigned, as shown in Table 1. The sum of the internal distances of the chain structure is 40 ($\sum$ dx, y = 40). The same method was used to calculate the sum of the ring structure, which is 30, and of the star structure, which is 32 [3].

According to these results, the ring should have been the fastest. However, the experimental results were exactly the opposite. Given this finding, Bavelas and Leavitt began to think about another factor: centralization. The more centralized a structure is, the better it performs. They used "centralization" to refer to the overall distance between outlying nodes and the most central node, which acts as an information integrator. The closer each game participant is to that integrator, the faster the puzzle is solved. Of course, channeling all information to a single integrator is not the only possible strategy to solve problems, [8].

The previously mentioned studies were developed based on an analytical method, so it would be interesting to study the communication patterns using instead engineering tools. Therefore, a study was developed based on Bavelas' work, but explained by engineering tools. This used the essence of the Bavelas study but with some variations, which will be explained later, to study the communication process through a formal statistical model that helps to validate the results and make them acceptable within the engineering field.

Table 1 Method to calculate the distances applying the chain structure. *Source* Bavelas, 1950, [3]

p	q	r	s	t
4.0	5.7	6.7	5.7	4.0
paq = 1	qap = 1	rap = 2	sap = 3	tap = 4
par = 2	qar = 1	raq = 1	saq = 2	taq = 3
pas = 3	qas = 2	ras = 1	sar = 1	tar = 2
pat = 4	qat = 3	rat = 2	sat = 1	tas = 1
P to all = 10	q to all = 7	r to all = 6	s to all = 7	t to all = 10

3 Statistical Model

This study is based on the work of the author Douglas Montgomery [8], who pro-posed a guide for experiment design.

3.1 Factors and Levels

Design factors are those aspects that the experimenter wishes to study and to vary in the experiment. Each of these factors has different levels, [9]. In this case there are two factors, as follows:

- Type of structure with four levels (factor A), as follows: star, ring, Y and chain structure (see Fig. 1). This factor was chosen to study its influence on the communication process. The four levels were taken from patterns of communication proposed in the literature, which were described previously in Sect. 2.
- Level of information complexity (factor B) with three levels: low, moderate and high. It was studied because previous studies have shown the level of information complexity also effects communication success. Three levels were chosen that satisfactorily cover the different complexities.

Time was chosen as the variable response, measured in the number of minutes that it takes for each group to successfully complete the communication.

3.2 Experimental Design Model

To conduct the study, a general factorial design was implemented. For experiments that aim to study the effects of two or more factors, factorial designs are more efficient. These designs study all possible combinations between the levels of the factors, in each complete trial or replication of the experiment [8]. Therefore, the model with the factors' interaction for the k-th response in the treatment $A_i B_j$ (level A combination of factor i with level j of factor B) is given below:

$$Y_{ijk} = \mu + A_i + B_j + (AB)_{ij} + E_{ijk}, \quad \text{with} \quad i = 1,2,3,4 \quad j = 1,2,3$$

where:

Y_{ijk} = is the k-the time that it takes for each group to find out the figure in common, at each level of information complexity.

μ = Overall mean time, measured in minutes.

A_i = the effect of factor A (structure) on the average time.

B_j = the effect of factor B (information) on the average time.

AB = the interaction effect of factor A and B on the average time.

E = experimental error.

There are three considerations for this model: the first is that the factors are fixed, i.e., the i level of the factor A, as the j level of the factor B, are set by the investigator and all levels are available for that factor. The second consideration is that the design is completely randomized, and the third is that it satisfies the usual assumptions of normality. These considerations will be checked during the study.

3.3 Experimental Execution

The game

Number of players: five.

Materials: five cards displaying graphics classified into three levels of complexity.

The purpose: to discover and determine which figure is common amongst five cards, using written language and following a previously assigned communication structure.

Development: The five players are organized according to the communication structure already given, determining the possible connections with other participants, i.e. not everyone can communicate directly with each other. Based on that structure, the groups must identify which figure is in common amongst all the cards as quickly as possible. This process will be applied for each different level of information.

The data was collected over two days, with three groups of five people.

The participants were undergraduate administrative and industrial engineering students in their seventh and eighth semesters. They were randomly divided into groups of five.

The structure was assigned to each group.

All groups were provided with the same information and game rules.

All groups started the game by playing in the lowest information level and continued until reaching the highest information level.

The time was recorded for each group to find the common figure.

3.4 Data Obtained

Each group gave three (3) answers, one for each level of information complexity, organized according to the structure assigned. Thirty six (36) data were collected with this mechanism, representing the time required for each group to find out the answer. These data were analyzed, as specified by the general factorial model, assisted by using Minitab 15® software [10].

The experimental plan is presented in Table 2.

Table 2 Experimental plan

Group	Information complexity level	Communication structure	Time
1	Low	Star	1.77
	Low	Chain	5.5
	Low	Ring	1.67
	Low	Y	0.67
	Moderate	Star	2
	Moderate	Chain	3.67
	Moderate	Ring	1.22
	Moderate	Y	1.37
	High	Star	3.17
	High	Chain	4.43
	High	Ring	4.67
	High	Y	4.5
2	Low	Star	1.17
	Low	Chain	2.17
	Low	Ring	3.67
	Low	Y	4
	Moderate	Star	2.5
	Moderate	Chain	1.75
	Moderate	Ring	2.33
	Moderate	Y	3.8
	High	Star	3.5
	High	Chain	2.87
	High	Ring	12.17
	High	Y	8.08
3	Low	Star	3.92
	Low	Chain	6.17
	Low	Ring	3.37
	Low	Y	1.1
	Moderate	Star	10.67
	Moderate	Chain	2.83
	Moderate	Ring	3.17
	Moderate	Y	2.8
	High	Star	9.03
	High	Chain	6
	High	Ring	9.02
	High	Y	6.5

Source Own elaboration

4 Calculation and Analysis of Experimental Results

4.1 Analysis of Variance

The Table 3 shows the results given by the software after execution of ANOVA, the analysis of variance.

4.1.1 Significance of the Structure Type

The analysis is similar for numerals b and c, therefore these points will not be discussed in detail.

Hypothesis test:

$$H_0 : \ a_1 = a_2 = a_3 = a_4 = 0 .$$

$$H_1 : \ a_i \neq 0 \quad \forall \ i = 1, 2, 3, 4.$$

H_0 means that changes in the type of structure don't generate changes in the response variable, and H_1 is understood as changes in the structure type that generate changes in the response variable.

Statistical test:

$$F_1 = MSA/MSE .$$
$$F_1 \sim F_{(a-1,ab(n-1))} = F_{3,24}.$$

Rejection criterion:

$$VP = P(F_{3.24} > F_1) < \gamma = 0.05.$$

Because VP = 0.86 > 0.05, the null hypothesis is accepted and it can be concluded that the structure type is not significant. In this way, with a confidence level of 95 %, the structure adopted by each group in the communication process does not affect its efficiency or success.

Table 3 ANOVA (with interaction)

Source	DF	Seq (SS)	Adj (SS)	Adj (MS)	F	P
Structure	3	4.317	4.317	1.439	0.25	0.86
Info.	2	77.631	77.631	38.86	6.76	0.005
Info. structure	6	52.855	52.855	8.81	1.53	0.21
Error	24	137.765	137.765	5.74		
Total	35	272.568				

Source Own elaboration using Minitab 15® software [10]

4.1.2 Level of Significance for Information Complexity

Hypothesis test:

$$H_0: \; b_1 = b_2 = b_3 = 0\,.$$
$$H_1: \; b_j \neq 0 \quad \forall j = 1, 2, 3.$$

The level of complexity of information is significant because VP = 0.005 < 0.05 = γ, and the null hypothesis is rejected. In this way, with a confidence level of 95 %, the level of information complexity has an influence on the efficiency and success of the communication process.

4.1.3 Significance of the Interaction Between Factors a and B

Hypothesis test:

$$H_0: (ab)_{11} = (ab)_{12} = (ab)_{13} = (ab)_{21} = (ab)_{22} = (ab)_{23} = (ab)_{31} = (ab)_{32} = (ab)_{33} = (ab)_{41} = (ab)_{42} = (ab)_{43} = 0\,.$$
$$H_1: (ab)_{ij} \neq 0 \quad \forall\, i = 1, 2, 3, 4; \quad j = 1, 2, 3.$$

The interaction of the structure type and the level of information complexity is not significant because VP = 0.21 > 0.05 = γ, and the null hypothesis is accepted. Therefore, with a confidence level of 95 %, the interaction of the levels of two factors has no influence in each treatment. With this result, it can be concluded that there is no statistical relationship between the structure type adopted and the level of information complexity, meaning that it does not affect the efficiency and success of the communication process.

The Fig. 2 illustrates the significance of factors related to the time required in the communication process and the interaction between them.

It shows the effect of each factor over time. It is notable that as the information type increases in complexity, the time required for communication also increases. In this sense, the change from moderate to high is much more significant than the change from low to moderate; this is consistent with the analysis already performed.

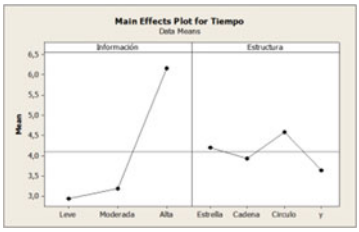


Fig. 2 Main effects on the time variable. *Source* Own elaboration using Minitab 15® software [10]

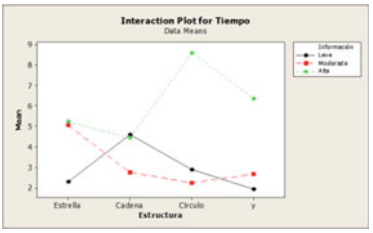


Fig. 3 Interaction effects between information type and structure, on the time variable. *Source* Own elaboration using Minitab 15® software [10]

On the other hand, the structure type does not have a significant effect on the time variable.

Figure 3 describes the effect of the interaction between the structure type and in-formation over the time variable. It is found that the interaction between the low In-formation type and the Y structure provides good results with timing, contrary to what happens when the low information type is combined with the chain structure. For the moderate information type, the interaction with the ring structure would be the most appropriate, and with the star structure, the least. Finally, the high complexity information type gives favorable results when it is combined with the chain structure, and unfavorable results when combined with the ring.

Although the ANOVA presents an insignificant structure, some combinations might be interesting since they could work well, as mentioned above.

Then the model equation is:

$$Y = \beta_0 + \beta_2 X_2 + \epsilon$$
$$MS_{tr}/MS_{Error} = 77.631/137.765 = 0.563.$$

The information type explains 56, 3 % of the model.

4.2 Validation of Assumptions

For the previous model to be valid, it is necessary to verify the assumptions of normality, constant variance and zero mean for the errors.

4.2.1 Normality

Hypothesis testing

H_0: ij normal distribution
H_1:ij abnormal distribution

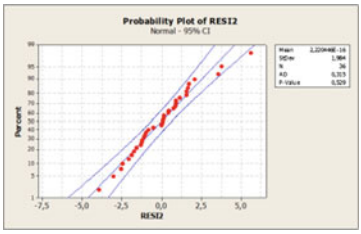


Fig. 4 Normality errors. *Source* Own elaboration using Minitab 15® software [10]

Rejection criterion:

$$VP < \alpha = 0.05.$$

Based on the Fig. 4, VP = 0.529 > 0.05, then the null hypothesis is accepted and it ensures the errors have a normal distribution.

4.2.2 Constant Variance

This assumption is verified by three steps, consisting of two tests and a graphic analysis. Bartlett's test was applied for the first instance, a test that tends to be less strong with few replicas per level and very sensitive to abnormality.

Now the equal variance of one treatment to another will be assessed, based on the following assumptions:

$$H_0 : \sigma_1^2 = \sigma_2^2 = \sigma_3^2 = \sigma_4^2 = ^{\sigma 2}$$
$$H_1 : \sigma_i^2 \neq \sigma_j^2 \quad \forall\, i \neq j$$

Rejection criterion:

$$VP < \alpha = 0.05.$$

• Bartlett's Test for Equality of Variances: Time versus Information:
95 % Bonferroni confidence intervals for standard deviations

Information	N	Lower	StDev	Upper
Low	12	1.17754	1.78462	3.46016
Moderate	12	1.64934	2.49966	4.84654
High	12	1.89961	2.87896	5.58195

Bartlett's Test (Normal Distribution) Test statistic = 2.36; p-value = 0.308.

Since VP = 0.308 > 0.05, the null hypothesis is accepted and it concludes that the variance is the same for all treatments, with 95 % of confidence.

• Levene's Test for Equality of Variances: Time versus Information:

The Levene test will be applied next, which is used to verify the variances homogeneity for the k treatments (three for this case). When there is certainty about the normality of errors, Bartlett offers more reliable results.

Hypothesis test:

$$H_0{:}\sigma_1^2 = \sigma_2^2 = \sigma_3^2 = \sigma_4^2 = \sigma^2$$
$$H_1{:}\sigma_i^2 \neq \sigma_j^2 \quad \forall i \neq j$$

Rejection criterion:

$$VP < \alpha = 0.05.$$

95 % Bonferroni confidence intervals for standard deviations.

Levene's Test (Any Continuous Distribution) Test statistic = 1.15; p-value = 0.329

As VP = 0.329 > 0.05, the null hypothesis is accepted and concludes that the variance is the same for all treatments, with 95 % of confidence, i.e. there is homogeneity in the variances.

- Residual Graphs: Structure versus Information

Once the previous two tests have been applied, an analysis of the variance will be conducted, using the residual graphs. These graphs are also used to verify the assumption of constant variance, to determine if the treatments have the same variance.

An analysis of Figs. 5 and 6 shows that overall; all values are within a specific range. While there are some atypical points outside the range for some structures and information type, the other standardized residuals are within the expected range for normally distributed errors, leading one to conclude that they have constant variance.

- Zero Mean

Zero mean for the errors is the last assumption, as validated by Fig. 7:

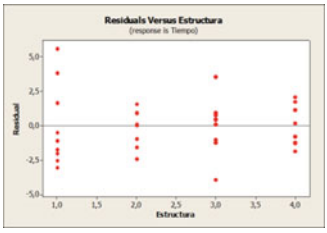


Fig. 5 Residuals versus structure. *Source* Own elaboration using Minitab 15® software [10]

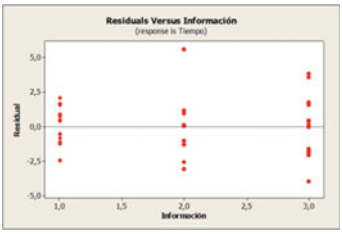


Fig. 6 Residuals versus information. *Source* Own elaboration using Minitab 15® software [10]

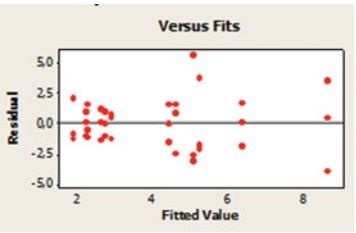


Fig. 7 Residuals vetsus adjusted value. *Source* Own elaboration using Minitab 15® software [10]

It can be observed from Fig. 7, that the points are uniformly distributed, without following a specific trend, and therefore it can be concluded that the residuals have a mean of zero.

After checking these three assumptions, the model becomes valid. The efficiency of communication depends, in statistical terms, on the combinations between the structure and level of information handled, or the structure itself.

5 Discussion of Results

5.1 Effects of Structure Type and Information Complexity on Communication

After executing the study based on the theory of experiment design, it was found that:

- Under a statistical analysis, the structure type has no significant effect on the efficiency of the communication process, a result that is consistent with the conclusion stated by Alex Bavelas and Harold Leavitt. They found that the centralization could have a more important effect on the efficiency in the communication process than the structure type, as they had anticipated.
- The effect on the communication process of the interaction between the structure type and the level of information complexity is not significant either, meaning that any combinations between structure and the level of information complexity will not affect the efficiency of the communication process.

- The level of information complexity does have a significant effect on the communication process, which is that the process of efficiency somehow depends on the level of the information.
- Although under a statistical analysis some factors do not influence the communication process, it is important to take into account the possible trends.

5.2 Conclusions

The efficiency of communication within an organization depends principally on the level of information complexity, and not on the design of the communication structure. The application of this result could be transferred to organizational diagrams; whereas many organisms operate in a hierarchal or linear fashion, they could function just as productively in a star or ring structure that graphically appears more equalitarian, and could thus promote a feeling of equality amongst employees and in turn increase work-place-cooperation. In the future it would be interesting to focus the study on just the complexity of the information and to conduct it in a business environment.

References

1. Emurian, H., Wang, Y.: An overview of online trust: concepts, elements, and implication. Comput. Hum. Behav. **21**, 105–125 (2005)
2. Rojas, M., Arango, P.Y., Gallego, J.: Confianza para efectuar compras por internet. Revista DYNA **76**(160), 263–272 (2009)
3. Bavelas, A.: Communication patterns in task-oriented groups. J. Acoust. Soc. Amer. **22**(6), 725–730 (1950)
4. Rojas, M.Y., Marin, J.S.: Aproximaciones a la medición de confianza. Revista DYNA **73** (150), 119–130 (2005)
5. Borgatti, S.: Communication Structure and its Effects on Task Performance. http://www.analytictech.com/networks/commstruc.htm [citado 13 de Febrero de 2012]
6. Bavelas, A.: Communication patterns in problem solving groups. Cybernetics, H. von Forester (comp.), Josiah Macy Jr. Foundation, New York (1952)
7. Cartwright, D., Zander, A.: Dinámica de grupos, pp. 548–557. Investigación y Teoría. México, Trillas (1971)
8. Montgomery, D.C.: Design and Analysis of Experiments. Wiley, New Jersey (2005)
9. box G.E.P., Hunter, J.S., Hunter, W.H.: Statistics for Experimenters: Design, Innovation, and Discovery, 2nd edn. Wiley (2005)
10. Marín, F.J.: Manual de MINITAB 15 (con aplicaciones a las Ciencias de la Docu-mentación). Departamento de Estadística e Investigación Operativa Facultad de Matemáticas. Universidad de Murcia, Murcia (2011)

Part XIX
Performance Management and Organizational Learning

Human Factor Related Challenges of Marketing Construction Business Enterprise

Jonas Yanka, Clinton Aigbavboa and Wellington Thwala

Abstract Marketing is acknowledged as a necessary business management function but its application in construction is intensely hindered by some human factors in the construction industry. The paper is aimed at identifying the specific human factors in the construction industry that hinder marketing adoption and implementation in construction and to initiate further debate on this important but Cinderella subject. It uses literature review as a method to identify, summarize, synthesize and show the gaps in the existing research knowledge on human factors affecting Marketing Performance (MP) of Construction Businesses (CB). Factors such as marketing skills, manpower, attitude towards and conception of marketing hinders greatly on MP of CB. Construction marketing researchers must focus attention on the human factors that affect construction marketing. Educational consultants, curriculum developers and training institutions will find the paper useful in revising existing curriculum to reflect current trends in the management of construction business enterprise.

Keywords Business management · Construction · Human factors · Marketing

1 Introduction

The enormity of changes and the intensity of competition in the construction industry today compel enterprises operating in the construction industry environment to adopt the right management function relevant in dealing with these chal-

J. Yanka (✉) · C. Aigbavboa · W. Thwala
Department of Construction Management & Quantity Surveying,
University of Johannesburg, Johannesburg, South Africa
e-mail: ekowjonas1@gmail.com

C. Aigbavboa
e-mail: caigbavboa@uj.ac.za

J. Yanka
Department of Building Technology, Cape Coast Polytechnic, Cape Coast, Ghana

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lenges [1] and marketing stands out in this regard. Construction enterprises today, are aware of the importance of involving marketing in their management functions as a way to adapt themselves not only to the continuous changes in the industry, but also to satisfy their clients' demands, while being competitive and improving their business strategy [2]. Notwithstanding this awareness, many researchers report of overwhelmingly low utilization of marketing in the management of construction business enterprises in the construction industry [3–8]. An examination of what marketing is and the processes for its implementation in a business reveals the indispensable role of the human factor inputs, if successful performance can be achieved.

Marketing is a subject of many definitions articulated by different authors to suit different circumstances [9]. For instance, marketing is defined as the competitive process by which goods and services are offered for consumption at a profit [10]. Marketing is described by Harris [11] as "the management function that organizes and directs all those business activities involved in assessing and converting customer purchasing power into effective demand for a specific product or service, and in moving the project or service to the final customer or user so as to achieve the profit target or other objectives set by the company". Marketing was defined by Kotler and Keller [12] in terms of human activity directed at satisfying needs and wants through exchange, and Ohmae [13] saw it as discovering what customers want and orienting the firm to satisfying those wants. A simplified definition of marketing is given by Scanlon [14] as 'the concept of matching services to wants in the market place'.

The definition of marketing put forward by the Chartered Institute of Marketing (CIM) is that: Marketing is a management process responsible for identifying, anticipating and satisfying costumer requirements profitably [15]. This definition highlights the 'management process' which involves the way in which the firm operates, by 'identifying, anticipating and satisfying customer requirements', as very important and also places the focus clearly on customer needs. Operating 'profitably', is necessary for the organization to remain in business to satisfy its customer's needs [16]. In addition, when considering 'customer satisfaction', it is also important to recognize this gaining of credibility and the building of a long-term relationship with the client, must be the primary concern of all staff [10].

Marketing management function in a business enterprise involves the practical application of marketing techniques and the management of a firm's marketing resources and activities [12]. The application of marketing techniques and the management of firms' resources certainly cannot be done without human factor inputs such as manpower, skills among others. The human factor inputs are further conspicuous in the four main steps in marketing management process, which are; (1) understanding the marketplace and customer needs and wants, (2) designing a customer-driven marketing strategy, (3) constructing a marketing program that delivers superior value and building profitable relationships, creating customer delight, and (4) capturing value from customers to create profits and customer equity [17].

The basic philosophy underpinning marketing is creation and/or retention of customers and improvement in business performance. As such it basically focuses on customer needs and wants [18, 19]. Due to that, the starting point in marketing management process is to 'understand the marketplace and the customer needs and wants'. This stage involves a continuous marketing research and analysis activities, which mainly focus on analyzing business opportunities in the market, collecting information about potential customers, competitors and the marketing environment, and then analyzing the company's strengths and weaknesses [20].

Marketing intelligence and information generated from the first stage of the marketing management process is used 'design a customer-driven marketing strategy'. In this stage, a company divides the market into major segments, selects the target market that the company can best serve, and develops differentiating and positioning strategy for the target market [20].

At this stage the enterprise 'constructs a marketing program that delivers superior value and builds profitable relationships, creating customer delight'. A marketing program should include decisions on marketing resources necessary to achieve marketing objectives and marketing techniques to be used to pursue marketing objectives in the target market. This stage focuses on how to best implement the chosen strategy [20].

Implementing the marketing program and building strong relationships with customers and marketing partners a company should 'capture value from customers to create profits and customer equity'. Marketing manager's responsibility is to constantly measure progress against marketing objectives in order to ensure that the implementation of marketing programs achieves the desired marketing objectives in a cost-efficient manner [20]. A variety of metrics, such as customer metrics (e.g., customer loyalty/satisfaction, brand image, etc.), market metrics (e.g., market share, sales volume, etc.), financial metrics (e.g., sales value, profits, etc.), etc., can be used to measure marketing performance [12, 17].

The four stages of the marketing management processes discussed had demonstrated the need for human factor inputs. The rest of the article is examines and explicates the human related factors in construction industry, that continues to challenge the marketing of construction business enterprises. Discussions on how the factors can be overcome are elucidated.

2 Human Factors and Construction Marketing Research

The paucity of literature available on construction and the intermittent nature of their occurrence have been remarked on by many others [21–23]. Development of marketing research in construction from 1970 until 2009 is shown in Fig. 1. Before 1995, the number of papers was very few and intermittent. After this year, an increased interest is evident: 50 % of the papers were published in the last decade. Figure 1 further indicates renewed interest of researchers in construction marketing. Despite this effort, there still exist challenges with the implementation of marketing

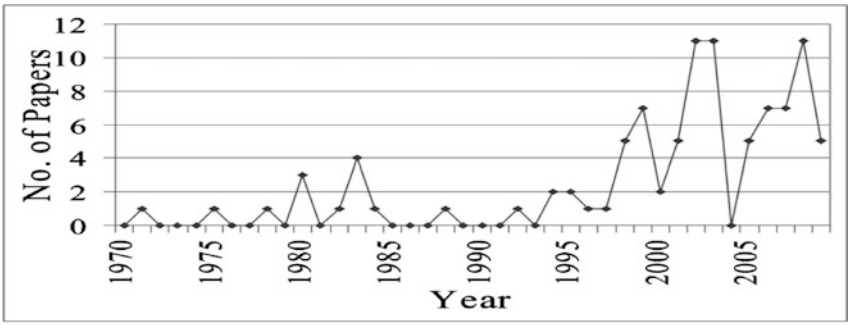


Fig. 1 Developments in construction marketing research. Adopted from Naranjo et al. [2]

in the management of construction business. These indications suggest that existing research findings may not be directly relevant in dealing with the existing marketing challenges in construction. Principal among these challenges is the human related factors of construction that affects marketing of construction business. Marketing being a management function means that human factor is critical to its implementation. The effectiveness of the implementation is largely affected by the manpower, skills and expertise required.

These arguments point out that the human factors involved in the process are indispensable if success can be achieved in this effort. However, the stark reality is that this aspect of construction marketing is scarcely researched. Figure 2 gives the aspects of construction marketing mostly investigated by researchers. The trend shows that the human factors are the least researched aspect of construction marketing in all construction marketing research over the period spanning 1970 until 2009 [2]. The research by Naranjo et al. [2] used a collection of papers in five databases. The databases comprised of Web of Science (ISI), Business Source Premier (EBSCO), and Engineering Village (EV), which includes Compendex,

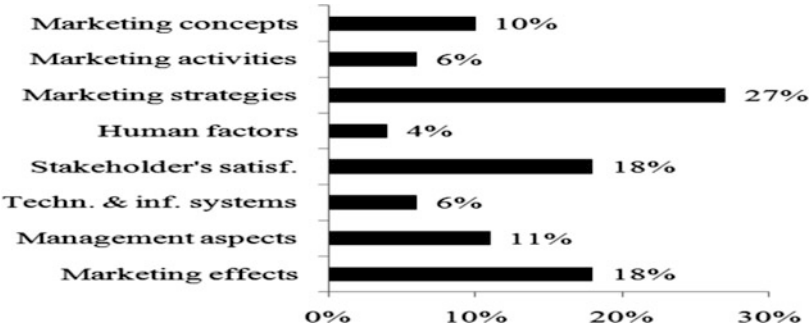


Fig. 2 Marketing aspects researched. Adopted from [2]

Inspec, and Referex. The reasons for the choice of the databases, according to Naranjo et al. [2] were 'because they are scientific, international, and related with engineering and business topics'.

3 Methodology

The study was conducted through a literature search and subsequent process and analysis of the papers found. The study includes a review of the well-known texts and most cited publications in referred journals but limited to papers that relates issues involving human factors in the marketing of construction businesses. In view of the low numbers of texts and literature on the subject of construction marketing, the search for literature was not restricted to any particular journal or group of journals. Electronic databases were used since such platform hosts a collection of texts and therefore provides a wide coverage of texts than does individual journals. The electronic databases used includes Google scholar, EBSCOHost and Science Direct.

The procedures adopted for retrieving papers related to human factor challenges in construction marketing were as follows:

1. The titles, keywords, and abstracts were scanned with the keywords. Several papers emerged that contained at least one of the keywords. The papers included articles that which focus on construction marketing, closely related papers and less related papers.
2. A review of the abstracts of these papers was conducted to filter out the less related papers. This was achieved by means of choosing technical papers and reviews, removing duplicate articles, and eliminating papers which were not strongly related with the topic of the study.
3. All the remaining papers were read, analysed and several descriptive words were identified. The sections that related to human factor challenges to construction marketing were extracted for further analysis.
4. Finally the human factor related challenges in literature were classified according their unique characteristics that are common to all.

4 Human Factor Related Challenges of Construction Business Marketing

Marketing as a management function requires human effort to see its implementation. The human factor component is critical as the success or otherwise of the implementation is solely dependent on the performance of the human factor involved in terms of their skills, knowledge among others. Such human factors can be examined in the context of the following.

4.1 Reluctance to Adoption and Integration of Marketing in Construction Businesses

In the view of Pheng [6] marketing has attracted only little attention among construction contractors and professionals alike. As noted by Morgan and Burnicle [24], the construction industry has been slow in adopting marketing principle. This, according to Morgan and Morgan [4] is due to the fact that marketing is still a new phenomenon viewed with scepticism. This indicates that the human factor involved in construction do not willingly see the need for marketing in the management of their business. Even if they say the need, there exists some unwillingness towards its acceptance.

Many studies have shown that construction firms' aside being slow in adopting marketing principles, marketing when adopted is not integrated into the structure of construction firms operations [23, 25–27]. It appears the people involved in the management of construction businesses lacks knowledge about how marketing can be integrated in their business structure and therefore unwilling to accept it.

4.2 Misconceptions and Misperceptions and Lack of Understanding About Marketing in Construction

Other studies have reported existence of many deeply held misconceptions or misperceptions or misunderstandings about the appropriateness and value of general management skills and marketing skills in particular, in the construction industry [21, 22]. According to Fisher [21] the result of this is that, construction firm owners do not seem to be aware of the economic payoff to be derived from the appropriate use of modern management systems and are, as a consequence, unwilling to incur the cost of operating these systems on their construction projects. Although marketing is a much larger idea than selling, professional firms show little interest in it because they equate it to selling which the professional body place ban against.

Similarly, Fisher [21] found that to a large number of firms marketing is seen as synonymous with selling. This in the view Yisa et al. [23] can be attributed to ignorance or misunderstanding of the concept of marketing in the industry. Similarly, Dikmen et al. [28] described equating marketing to selling as one of the misconceptions about marketing in the industry. This in the view of Yisa et al. [23] can be attributed to the fact that literature on marketing in construction is sparse, suggesting that the industry's professionals are being educated without a systematic study of marketing which is an important aspect of management. It is obvious that this has resulted in the reluctance to the adoption and implementation of marketing in the construction industry.

It was noted by Bell [29] of the existence of a wide misconception/perception that only clients can create demand for work, and that the firm themselves are not capable of doing so. Other researchers also argue that the industry is not capable of

being planned, citing the dynamic environment as a reason that prevents any long and medium term planning [3, 30]. It was indicated by Peck [7] that some consulting firms are still struggling to understand and implement effective marketing programmes. It has been stated [4] that marketing is less developed in the construction industry and often performed in most firms in an ad hoc basis. These assertions buttress the argument that management members in construction have not yet grasped the true meaning of marketing. The low utilization of marketing in construction can therefore be attributed to this lack of understanding of marketing.

4.3 The Beliefs in the Construction Industry

It is noted by Friedman [31] that the construction firms in the past have not met with difficulties in obtaining the required level of works to maintain survival and profit. So they rely on their reputation and quality of their work to continue winning new order. This prevents them from recognizing the essence of marketing. It was pointed out by Pearce [30] that the most popular belief in the industry is that, the most important part of the organization is the production side. The result according to Yisa et al. [23] is that the professionals look for opportunities that fit their capabilities rather than adapting their capabilities to suit current and future market opportunities.

The effect of this belief is that the construction businesses do not make any conscious effort in seeking out new clients or moving into new, less crowded businesses environments. As a result construction businesses may have no need for marketing.

4.4 Lack of In-house Marketing Expertise

The findings of Yisa et al. [23] revealed that, in a larger percentage of firms marketing is managed by a partner/director/senior manager, in addition to other responsibilities. As indicated by Yisa et al. [23], the percentages as 95, 80 and 22 % for architects, engineers and contractors respectively. This indicates a lack of importance placed on marketing and as a result, no expert is employed to oversee it, rather it is added to the responsibilities of others who may even have no knowledge about it. The lack of in-house marketing expertise can also be attributed to the issue of low consultation fees that reduces the firms' revenue thereby making it difficult for the firms to pay for the services of a marketing expert. Whatever the reason might be, given the responsibility for marketing to an in house personnel will not yield any reasonable results. The in-house personnel is reluctant to accepting marketing, do not understand marketing, lacks knowledge on how to integrate marketing in the business structure of construction, holds on to a believes that makes him think that marketing is not needed in construction.

4.5 Engineers Paradigm

According to Dikmen et al. [28] the presence of cultural barriers in the industry is a resistance to marketing oriented approach to management of in the industry. Similarly, Seymour and Rooke [32] observe that management practices are dominated by the engineers' paradigm which has resulted in the limited use of market-driven strategic management. With engineers dominating the management of construction businesses means that their beliefs largely influences their management practices. Their belief is that the most important part of the business is production but management of which marketing is a key component. As a result much attention is paid to production efficiency and quality of services than any the management related issues. This in the view of Richardson [22] is a hurdle that needs to be overcome if marketing can be adopted and implemented in the effectively the construction industry.

4.6 Marketing Resource Constraint

From Yisa et al. [23] estimation, resources for managing marketing in an organization can be categorized into manpower, skills and budget. The adequacy of these resources can guarantee a successful marketing program in the industry. However, because of the low consultation fees charged [33] the firms are not able to allocate adequate funds to support marketing activities. Much attention is paid to the production side [30] than the management side of which marketing is key [28]. Less resources in terms of manpower is assigned to the management of marketing as most firms do not even have marketing department let alone men to manage such departments [23].

The limited budget prevents the firm from sourcing the services of external marketing experts. This is because the available funds are used to cover operating costs and production related issues such as supervision [33] that are considered as most important part of the firm [23]. Regarding the skills in terms of marketing skills the professionals are handicapped because their education and training are geared towards production of highly scientifically trained profession with little or no management training [11] because the professionals believe that the important part of the organization is the production side but not the management side [30] of which marketing is an important tool.

4.7 Effect on Construction Business Marketing Practices

This has resulted in the preference for minimal marketing in the construction industry. A large number of construction enterprises both contracting and professional firms, except those firms engaged in speculative house building, practice

minimal marketing. They avoid or minimize conscious development of a marketing program. The firms feel that they will attain their objectives by rendering the best quality service to existing clients. They reason that a high quality of service will lead to satisfied clients, who will place their new business with the firm. Furthermore, satisfied clients will recommend the firm to others, thus leading to a substantial inflow of new clients. This approach to doing business is not tenable in business environment of construction business.

5 Discussions

The study examined the human related factors in construction business enterprise that affect effective marketing management of construction businesses. It is the first study that highlights the challenging effect of human related factors in construction to the marketing of construction businesses.

The results are clear of the potential effect of human related factors in the marketing of construction business such as: construction business management's reluctance to adoption of marketing as a business management function, lack integration of marketing in the business chain of construction, lack of understanding or misperceptions and misconceptions about the true meaning of marketing, beliefs in the industry that 'so long as we do good work we will always have plenty of work', engineer's paradigm, lack of in-house marketing expertise and constraints in marketing resources in terms of marketing skills and manpower for marketing activities. All these factors are related to humans in various levels of management in the construction industry.

Most of the human factors examined require mental orientation of construction management team members involved in construction far more than instituting some specific measures in place, no matter how pragmatic those measures could be. That will require some in-service education and training about marketing for construction management team members. Factors lack of understanding, misperception, misconception and misunderstanding of marketing can be overcome with education and training of construction management team members. Once this is dealt with the other challenges such as reluctance to adoption and integration of marketing in construction, beliefs in the industry, engineer's paradigm, resource constraints, lack of in-house marketing and others would have been dealt with indirectly. All these factors are ripple effect of the root cause—lack of understanding of the true meaning of marketing.

In the meantime, management can also employ the services of marketing professionals as a way of overcoming the challenge of lack of in-house marketing expertise. Increasing the numerical strength of individuals whose responsibilities are solely dedicated to marketing or staff at the marketing department will also improve on the marketing resource constraint due to manpower requirement for marketing activities. Some limitations may be related to the collection of secondary data for the study. Also, the study did not examine the education and training of

construction management team members so as to establish its effect on the mental orientation of construction management team members about marketing in the management of construction business.

The confidence in the results could be strengthened with inclusion of more electronic databases so that other possible human related factors affecting construction marketing can be highlighted. These recognized shortcomings could inspire researchers to define their future research agenda. Again, future work should examine other potential factors that might influence mental orientation of construction management team members about marketing. In particular, the content and structure of construction education curriculum, the relevance of the teaching methods adopted towards the acquisition of useful knowledge and skills, the competency of the teachers for teaching marketing to construction students and the preparation of academic staff for teaching marketing to construction students.

References

1. Yankah, J.E.: Marketing performance of quantity surveying consulting firms. Int. J. Constr. Eng. Manag. (IJCEM) **4**(6), 230–237 (2015)
2. Naranjo, G., Pellicer, E., Victor, Y.: Marketing in the construction industry: state of knowledge and current trends. Dyna **78**(170), 245–253 (2011)
3. Moore, A.B.: Marketing Management in Construction Industry: A Guide for Contractors. Butterworth's, London, England (1984)
4. Morgan, R.E., Morgan, N.A.: Marketing consulting engineering services. Civil engineering surveyor, 20–21 June (1990)
5. Morgan, R.E., Morgan, N.A: An appraisal of the marketing development in engineering consultancy firms. Constr. Manag. Econ. **9**(1), 355–368 (1991)
6. Pheng, L.S.: World markets in construction: a regional analysis. Constr. Manag. Econ. **9**, 63–71(1991)
7. Peck, W.F.: Making the most of marketing. J. Manag. Eng. **10**(6), 17–21 (1994)
8. Rwelamila, P.D., Bowen, P.A.: Marketing of professional services by quantity surveying consultancy practices in South Africa. RICS research (1995)
9. Yankah, J.E.: Principal barriers to marketing performance of quantity surveying consulting firms. Afr. J. Appl. Res. (AJAR) **2**(2), 126–139 (2015)
10. Pettinger, R.: Construction Marketing: Strategies for Success. Macmillan Press, London (1998)
11. Harris, F.C.: Modern Construction Management, 3rd edn, pp. 203–215. BSP, Oxford (1991)
12. Kotler, P., Keller, K.: Marketing Management. Pren-tice Hall, NJ (2008)
13. Ohmae, K.: Getting back to strategy. Harvard Business Review (1988)
14. Scanlon, B.: Marketing of Engineering Services: Engineering Management Series. Telford, London, England (1988)
15. Chartered Institute of Marketing (CIM) (Online). http://www.cim.co.uk/libinfo/index.htp. Accessed 3 Sept 2001
16. Pearce, P.: Marketing Construction. Construction Papers No. 94 (Englemere, Ascot: The Chartered Institute of Building) (1998)
17. Kotler, P., Armstrong, G.: Principles of Marketing. Pearson, London (2009)
18. Chatered Institute of Marketing (CIM): Marketing and the 7Ps: A Brief Summary of Marketing and How It Works. The Chartered Institute of Marketing, London (2005)
19. Palmer, A.: Principles of Marketing. Oxford University Press, New York (2000)

20. Polat, G., Donmez, U.: Marketing management functions of construction companies: evidence from Turkish contractors. J. Civil Eng. Manag. **16**(2), 267–277 (2010)
21. Fisher, N.: Marketing for Construction Industry: A Practical Handbook for Consultants, Contractors and Other Professionals. Longman's, London, England (1986)
22. Richardson, B.: Marketing for Architects and Engineers: A New Approach. Chapman & Hall, London (1996)
23. Yisa, S.B., Ndekugri, I.E., Ambrose, B.: The marketing function in the UK construction contracting and professional firms. J. Manag. Eng. **11**(4), 27–33 (1995)
24. Morgan, R.E., Burnicle, J.L.: Marketing communication practices in house building firms. Build. Res. Inf. **19**(6), 371–376 (1991)
25. Bennett, R.: Marketing policies of companies in a cyclical sector: an empirical study of the construction industry in the United Kingdom. J. Bus. Indus. Market. **20**(3), 118–126 (2005)
26. Cicmil, S., Nicholson, A.: The role of marketing function in operations of a construction enterprise: misconceptions and paradigms. Manag. Decis. **36**(2), 96–101 (1998)
27. Winter, C., Preece, C.N.: Relationship marketing between specialist subcontactors and main contractors—comparing UK and German practice. Int. J. Constr. Mark. **2**(1), 1–11 (2000)
28. Dikmen, I., Birgonul, M.T., Ozcenk, I.: Marketing Orientation in Construction Firms: Evidence from Turkish Contractors. Build. Environ. **40**, 257–265 (2005)
29. Bell, R.: Marketing and Large Construction Firm, Occasional Paper No. 22. Chartered Institute of Building, Englemere, England (1981)
30. Pearce, P.: Construction Marketing: A Professional Approach. Telford, London, England (1992)
31. Friedman, W.: Construction Marketing and Strategic Planning. McGraw-Hill, New York (1984)
32. Seymour, D., Rooke, J.: The culture of the industry and the culture of research. Constr. Manag. Econ. **13**(6), 511–523 (1995)
33. Jaafar, M., Aziz, A.R.A., Wai, A.L.S.: Marketing practices of professional engineering consulting firms: implement or not to implement? J. Civil Eng. Manag. **14**(3), 199–206 (2008)

Sustaining LNG Business Through Engineering Professional Development Program

Nugrahanto Widagdo

Abstract Badak LNG has operated for more than 30 years with total production capability of 22.5 million metric ton LNG per year. The sustainability in LNG operation in these extensive years could not be achieved without supports of the whole employees, particularly engineers. System in maintaining engineering competency to provide contribution to the company is called the Engineering Professional Development Program (EPDP). In this paper, detail introduction of the system, including system element will be provided. Moreover several analyses, such as SWOT and Porter's Five Forces of Competitiveness analysis are performed to determine the expected performance of engineers. The outcome of analyses reflects on the significant contribution of the engineers, even beyond the engineering function. The program has proven to clearly improve the engineers' performance which consequently support and promote the company level of performance, as well as recognition from external parties.

Keywords Engineering Professional Development Program · Competency models · Competency assessment · Development plan

1 Introduction

Located in Bontang, Indonesia, Badak LNG currently has 8 process trains and its supporting facilities, capable to produce up to 22.5 million metric ton LNG per year and 1 ton LPG per year. During the establishment, the company has become one of the largest LNG plant in the world with its peak production in 2001. In more than 3 decades Badak LNG produced LNG and LPG, and supplied it to many countries such as Japan, South Korea and Taiwan, merely because less infrastructures are available in Indonesia. From the beginning of operation, going through numerous expansions and debottlenecking projects, the sustainability in LNG operation could

N. Widagdo (✉)
Technical Department, Badak LNG, Bontang 75324, Indonesia
e-mail: nugrahantow@badaklng.co.id

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be maintained. This achievement is possible because of support from the whole employees.

As an operating company, Badak LNG realizes that human capital is the main resources for the company. Therefore Badak LNG has several dedicated development paths for the personnel. There are OMDP (Operation and Maintenance Development Program), PDP (Professional Development Program) for non engineering and EPDP (Engineering Professional Development Program). Each of the program is specifically designed for the related personnel and has similar objective which is to ensure competence development for the members. These programs are originally formed to sustain the knowledge obtained from the plant operation and guide to achieve expertise in each discipline. During initial years of operation, as one of several new LNG plants in the region with the new technology that required specific expertise, personnel efforts, particularly engineers in learning and adapting to the plant operation need to be compiled and delivered to the next generation of engineers.

On the next journey, the plant operation would require several adjustments or modifications to overcome the problems. This is particularly the main role of engineers to troubleshoot and solve the operational difficulties. Moreover during years of the train expansion, additional role of engineers are required to develop and/or review the design of the plant. The requirement even more critical now when engineers are needed to anticipate the incoming lean feed gas for gas processing in the near future. Due to these challenging opportunities, that is why engineers are required to be prepared and developed.

2 Overview on EPDP

Badak LNG awares that the company has a dependency on engineering. With the current technology and challenges facing by the company, engineers are mandatory to be ready to answer by showing the productivity to improve the company competitiveness. If the company survives in the competition, the company business is sustained. This is the main background of EPDP that the company business will drive the engineers requirements.

The main focus of EPDP in developing engineers is achieving the required level of professional engineers who can meet the diverse challenges of proven methodologies, new technology, limited resources, intense competition, and changing operating conditions [1]. EPDP acts as a tool for the company in reaching the business goal through cost-effective development of engineers in acquiring the necessary knowledge and skills.

The program is divided into 4 levels of engineering, as follows:

1. Entry Level
   Program of Entry Level is provided for newly recruited engineers during their first year [2]. The program serves as fundamental practice for an engineer and covers job orientation and adaptation program for understanding system in the

company. This program also develops skills such as communication skill, team working and confidence, which is similar with survey result from CIPD that highlights important skills for young employees in their first year in the job [3].

2. Professional Engineering Level
   Starting in this level, engineers shall perform several job assignments to meet with the required tasks and behavior competencies. This level is the development phase. This level commonly will vary among engineer. The rate of progression will be determined by their individual performance and professional growth. The evaluation would depend on the ability to accomplish the job assignments, in terms of detail and coverage of review.
3. Senior Professional Engineering Level
   Engineers at this level are expected to deliver significant contribution through knowledge application and necessary technical advice to Management. Highlight of the level besides the substantial contribution is the task mastery and professional recognition.
4. Chief Professional Engineering Level
   At this level, engineers shall be able to provide strategic review and perform as internal consultants, particularly for company business matters. A Chief Engineer shall also be capable to handle major project with high complexity which may impact to the overall plant operation.

The function and orientation of the engineering levels could be seen on Table 1.

Each level has several task and behavior competencies that must be achieved in order to obtain higher qualification. These task and behavior competencies are selected competency models which fit with the company culture and business needs. It is expected that with these competencies, the company could focus on engineers development, performance appraisal and even succession planning in the organization and still aligned with the company needs.

In developing engineers to achieve certain competency models, EPDP uses more job assignments rather than trainings or workshops. This practice corresponds with the use of 70:20:10 principles [3]. This principle focuses on the learning process that is not only obtained from formal learning, but from work experience. Besides this practice could significantly improve the competency, the strong correlation and involvement of job assignment could enhance satisfaction and deliver lower job stress [4].

Table 1 EPDP engineering levels [1]

Level	Function	Orientation
Chief Professional Engineer	• Internal consultant • Special and complex projects	Business strategy/policy review
Senior Professional Engineer	• Advisor • Moderate size and complicated projects	• Task mastery • Significant contribution
Professional Engineer	Development phase	• Independent • Minimum supervision
Entry level	Familiarization	Company system and procedures

In order for the EPDP tool to be implemented within the company, a system shall be formed. As a system, EPDP comprises of working elements that have specific activities to implement the performance measurement and development for engineers. If we use PDCA cycle to observe EPDP as a system then it will be as the following:

1. Plan
   This is an initial step which covers the identification on requirements of EPDP. Organizational structure which defines related personnel and committees, related documents and assessment tools and procedures have been determined.
2. Do
   The second step is to perform the competence measurement on engineers through assessment by coaches. At first, coach will assess the progress of engineer development to achieve certain level of competence in Professional Development Meeting. Once completed, coach will determine the development plan to improve engineer competence through job responsibilities, rotational assignment, training, and special assignment.
3. Check
   There are 2 methods on checking step. The first one is by coach, who will regularly monitor the engineer progress through coaching process/forum in completing the assignments and development plan. The second one is by EPDP Committee, which will perform audit to observe and ensure that the system runs on the right direction.
4. Act
   Based on audit results, feedback and inputs from Management (through EPDP Steering Committee), an improvement on the system will be followed up.

Cycle of PDCA for EPDP is shown on Fig. 1.

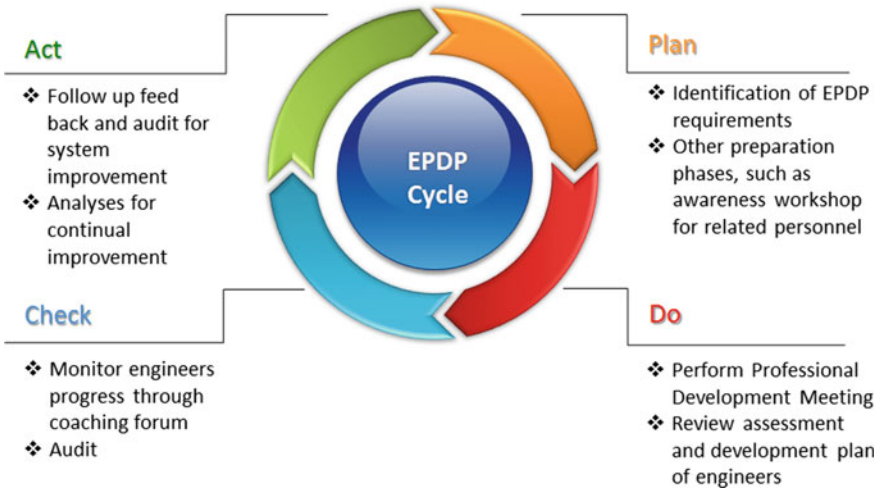


Fig. 1 EPDP cycle

3 EPDP Business Opportunity Review

In continuing support for the company to be sustained, an initiative is required. Supporting the company and at the same time maintaining the engineers development need to be considered. Therefore EPDP has conducted a review to analyse the current condition for further business opportunity. Since the scope of review is in corporate view or related with future LNG business, then tools that are used are closely related with business review. Two tools are selected for this purpose, SWOT and Porter's Five Competitive Forces.

3.1 SWOT Analysis

SWOT analysis is the common and broadly used tool for evaluating company strategy in a certain condition. SOW is the acronym of Strengths, Weaknesses, Opportunities and Threats. Its acronym is used as factors in reviewing the business need. The tool was introduced in the late 60's in a book of Business Policy, Text and Cases by Edmund P. Learned, C. Roland Christiansen, Kenneth Andrews, and William D. Guth [5].

The method defines the evaluation based on internal and external environment of the company. The Strengths and Weaknesses represent the internal factors, the Opportunities and Threats are the external factors. This is the base for assessing the internal company potential and limitation and the Opportunities and Threats from the external environment. The current SWOT analysis is performed to evaluate the internal environment, which is current EPDP and company condition as well as the external company business. The description of identified SWOT factors is as the following:

1. Strength
   Strength provides the current capabilities in solving the problems to achieve the objectives. This factor is the foundation for the company to obtain more success and opportunities. The Strength factors identified for the company are as follows:

   a. Reputation of EPDP in internal company.
   b. Period of coverage for engineer development.
   c. Budgetary aspect.
   d. Scope of development, which is not purely technical, but also social and business skills.
   e. Performance measurement of engineers.
   f. Uniqueness of EPDP system, which represents company culture and business needs.

2. Weaknesses
   This factor is the drawbacks which need to be highlighted to improve the condition. Several identified Weaknesses are the following:

   a. Program organization, which needs more tweaking.
   b. New Trend/Technology, currently for engineers are limited.
   c. Communication issues.
   d. Lack of experienced engineers.
   e. Limited resources for engineer exposures.
   f. Time constraint between coaches and engineers.

3. Opportunity
   Next factor is Opportunity that will provide advantage to the company, if the plan is executed. Benefits that occur from Opportunity comes from responding to external challenges or efforts to mitigate adverse effects. Items included in Opportunity are:

   a. HR system integration for improved coordination.
   b. Knowledge sharing session for establishing engineering practices and related plant histories.
   c. External cooperation for engineers development.
   d. Knowledge and skill validation for recognition.
   e. Business development, through services for similar companies.
   f. Market demand for expertise in LNG business.

4. Threats
   This last key factor is important to be taken into account, since Threats could delay or prevent productivity or effectiveness the organization. These external factors could not be controlled. Therefore strategies need to be determined to face these factors. Identified items related with Threats for Badak LNG are as follows:

   a. Global business condition, which is reflected from oil price drops and currency fluctuation.
   b. Intense competition with the incoming newly built LNG plants.
   c. Potential Government policy change for Badak LNG [6].
   d. Government regulation and energy policy challenges.
   e. Competent personnel demand in oil and gas, particularly in LNG business [6].
   f. Changing Feed Gas Quality, which may affect the plant operation [6].

All items are reviewed and inserted in overall figure of SWOT in form of spider webs. Each items is measured based on the leading or main impact for the related factors. Level 0–5 are provided to describe this measurement with level 5 as the most dominant and level 0 for no impact on the each factor (Fig. 2).

From the analysis using spider web form, the most dominant factor for each item in SWOT could be determined. From Strength factor, the uniqueness is the most

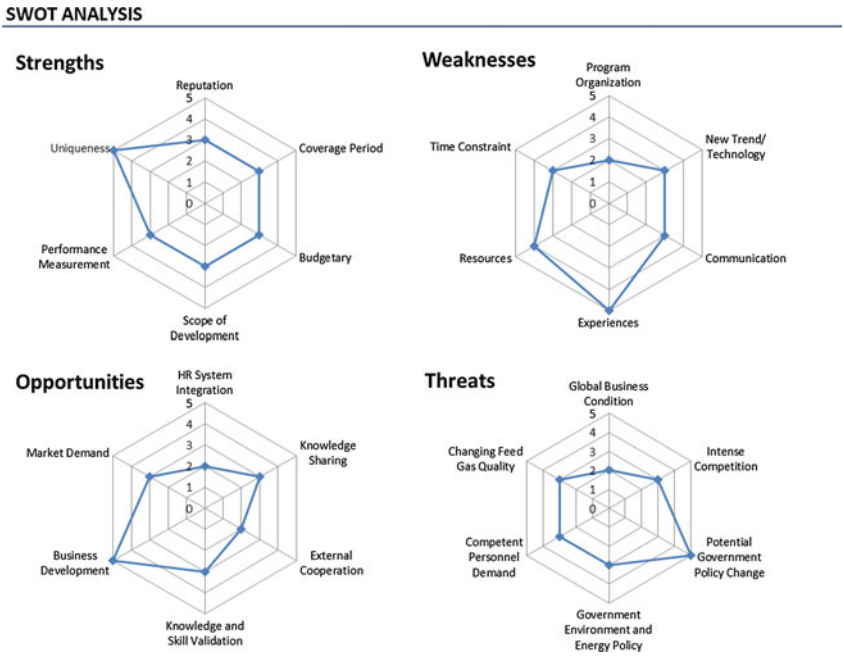


Fig. 2 Impact measurement on SWOT analysis

dominant due to adaptive types of competency models to go along with company culture. Weaknesses highlight the lack of experiences that are critical in anticipating more senior personnel retirement. While Opportunity identifies potential business development that Badak LNG needs to be exploited. Lastly, Threat determines potential government policy change as the factor that provide worst consequence since it discusses the possibility of the company closure. These four highlights are the priorities for further follow up to improve the system, although item of potential government policy change could not be totally solved since it will also depend on government view on Badak LNG.

Furthermore, besides determining the priority for further actions in EPDP, SWOT could also determine the solution for several items in each factor by using SWOT Matrix. SWOT Matrix analyze two factors to determine strategy to improve or sustain those related factors. SWOT Matrix for EPDP is shown Table 2.

3.2 Porter's Five Competitive Forces Analysis

The Five Competitive Forces analysis was introduced by Michael Porter and currently has been extensively used for determining the market attractiveness of a company [7]. It can be used for a company to review the current market, or enter

Table 2 SWOT matrix for EPDP

	Strength	Weaknesses
Opportunities	Related strategies or actions would be: • Utilizing competent engineers in providing engineering assistance for other company, initiated as new business development for Badak LNG • Assigning engineers to other companies with certain agreements to develop their competencies which at this moment rarely occur in Badak LNG	The required actions are are: • New business development could mitigate the lack of new trend/technology knowledge and skill for engineers • The assignment to other companies could be beneficial in responding to limitation of rotational assignment in the company • All of these efforts eventually could provide contribution in accelerating the engineers development to have enough experiences
Threats	Actions in responding the threats are: • Challenge in anticipating the change of feed gas quality to optimize the LNG plant condition • In responding to global business and condition, engineers shall be triggered to perform many cost efficiency proposals to sustain plant performance • Another intriguing items are conducting engineering improvements for beyond environmental compliance and developing strategy for energy efficiency programs	Actions to overcome or minimize threats are also the efforts in reducing weaknesses. Those are as the following: • Providing challenging assignments to improve competency to obtain more experiences within shorter time • Providing more opportunity to expose more engineers through engineering forums or workshops to acknowledge new trend or technology

new market, or new company to understand the market condition. The review is based on five external crucial factors from a company perspective to be considered competitive in the market. For Badak LNG, the review is based on the company condition in the market, with the addition of related challenges/Opportunities for engineers. The Five Competitive Forces analysis of Badak LNG is given on the Fig. 3.

From the figure, additional inputs which may provide opportunities for engineers are proposed on each force. Those are as follows:

1. New Market Entrants
   This force dedicates to observe the incoming new LNG plant that intends to enter the competition. Furthermore Badak LNG has the opportunity to assist this new LNG plants through training, commissioning and start up services by engineers.

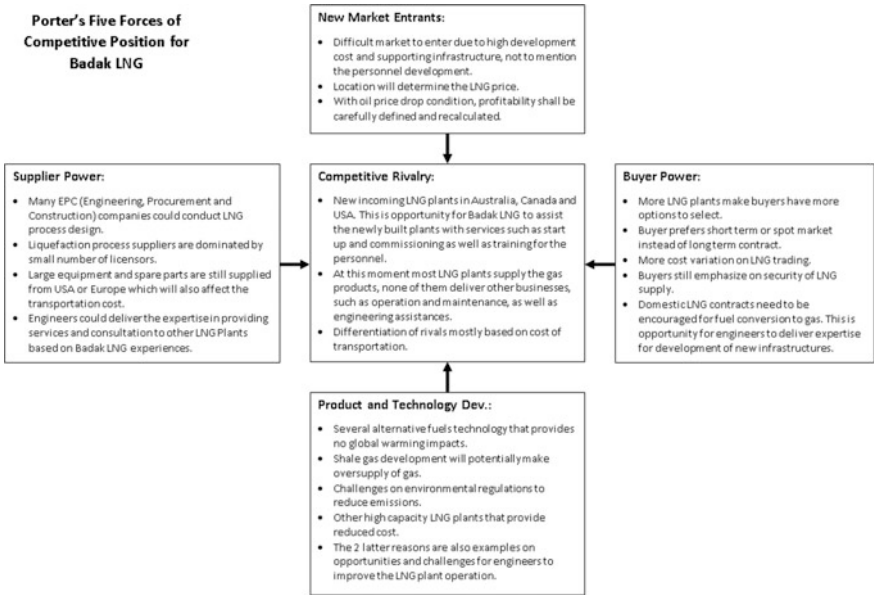


Fig. 3 Five forces of competitive position for Badak LNG

2. Product and Technology Development
   This force considers the customers perspective to find the new products or services to replace the ones that company have been produced, which is LNG/LPG. However this force also provides challenges for engineers to ensure the plant becomes more energy efficient and environmental friendly.
3. Supplier Power
   The force highlights on market condition of suppliers. The force observes numerous suppliers that provide products or services to the company, and their quality of products or services to the company. The company could provide similar level of services, not for supplying the equipment, but for maintenance services with additional value of best practices from a mature company.
4. Buyer Power
   Buyer power describes the expectation of consumer to the company, such as ranges of products and services, availability and delivery schedule. Badak LNG experience could be beneficial in providing advices and engineering services for developing domestic gas and LNG infrastructure.
5. Competitive Rivalry
   This force is the level of rivalry of the company in the business, by describing number and magnitude of competitors, ranges of offered scope of supply, and competitive strategy. Badak LNG has identified the competitors, which most of

them are newly emerged LNG plant (approximately 10 years of operation or less). However since Badak LNG has open opportunity to conduct more services to the LNG plant and gas industries, the company believes that the company business could be sustained.

So in overall perspective, there is still opportunity in each force for Badak LNG to enter the market through several approaches.

4 Discussion

Both SWOT and Five Force of Competitiveness analyses shows that there are many business opportunities for the company, especially related with engineers. The most important thing is how to implement the identified opportunities. This was not easy since it modifies the current culture from operating the LNG plant and initiating modification for plant improvements to open for new boundary internationally.

In realizing the results of analyses, attempts were determined in dividing the focus into 2, based on the purpose. Those are as the following:

1. New business development, which generates benefits for the company. Efforts for this purpose are as the following:
   - Engineering services, such as providing engineering assistance for operational problems, commissioning and start up assistance.
   - Training and workshops for other company. In this case, engineer has the opportunity to become the instructor.
2. EPDP breakthrough projects, which is aimed for engineers development. Projects included in this category are:
   - Initiating the external cooperation, particularly with the national oil and gas company to obtain exposure in grass root projects.
   - Developing more engineering assignments through challenges in environmental and energy issues.

Some of the attempts have been performed and providing advantages to the company. In delivering engineering services, besides satisfactory comments from the customers, good reputation and additional revenue could be obtained. Engineers as the human capital of the company also receive benefits in form of exposures in adapting to new environment, learning from new issues and developing social skills such as communication.

In internal view, in addition to new challenges that company must be prepared, such as environmental and energy issues, as well as the potential changing feed gas quality, engineers are also prepared for beyond engineering skills. This is shown from engineers' involvement in various company task forces. Their involvement has provided influential result on the team as displayed on the task forces outcome.

Table 3 Engineers involvement in company task forces

No.	Task force name	Engineer influences	Result
1	ISRS8 Assessment	• 29.17 % of the task force members are engineers • Related engineering responsibilities are such as preparing engineering review, project engineering and PHA review	Badak LNG was awarded with Level 8, which is the highest among oil and gas companies in the world
2	Safety and Environmental Audit from Government	• 33 % of the task force members are engineers • Related engineering responsibilities are performing environmental engineering analyses, water and energy efficiency improvement	• Badak LNG was awarded as Gold Category (the highest level of award) for environmental audit from Environmental and Forestry Ministry for 5 times in a row • The company also rewarded with award from Labor Ministry for more than 68 million safe manhours, in addition to occupational health and safety management system compliance
3	Phillip Townsend Associates, Inc. on LNG Plants Benchmarking	• 27.78 % of the task force members are engineers • Related engineering responsibilities are such as providing plant process parameters, plant losses, and emission calculation	Badak LNG recorded some of outstanding achievement such as in Lost Time Incident, Reliability Factor and Maintenance Cost

Table 3 describes the small number of engineers' participation in various task forces and their achievement. It is clearly proven that even with the limited resources, engineers could provide optimum outcome for the company. Hence engineers capability in contributing to any company needs are remarkable. For that reason the company needs to ensure that their competence development is assured.

5 Summary

Experience in operating LNG plant for over than 30 years has provided Badak LNG with outstanding track records, not only in plant operation, but also in terms of business sustainability. Badak LNG also realizes that as a mature company, sustaining the business and remained competitive in LNG business is important. Therefore efforts were made by highlighting the main capital that the company has, the human resources, which in this case, particularly is engineers. In

developing the engineers competence, there are obstacles and limitations on the routine activities, which requires business opportunity review. Analysis on SWOT and Five Force of Competitiveness has proven in delivering an insight for the company to go forward.

Attempts to implement all key actions have been initiated and start providing promising results. When all of the attempts are implemented, the company should have more competitive advantages among the industries. These advantages will assure the company attributes and business sustainability.

References

1. Badak LNG: Engineering Professional Development Guideline. Bontang, Indonesia (2015)
2. Badak LNG: EPDP Entry Level Program. Bontang, Indonesia (2015)
3. Chartered Institute of Personnel and Development: Research Report—Developing the Next Generation. London, United Kingdom (2015)
4. Saleh, S.D., Desai, K.: An empirical analysis of job stress and job satisfaction of engineers. J. Eng. Technol. Manag. **7**, 37–48 (1990)
5. ProvenModels B.V.: SWOT Analysis. http://www.provenmodels.com/37/swot-analysis/c.-roland-christensen–edmund-p.-learned–kenneth-r.-andrews–william-d.-guth
6. Badak LNG: BSMART SOP—03-12 Business Risks. Bontang, Indonesia (2015)
7. Porter, Michael E.: Competitive Strategy—Techniques for Analyzing Industries and Competitors. The Free Press, New York (1998)

Safety Management Tasks at Different Management Levels

Sari Tappura, Anna-Maria Teperi and Jouni Kivistö-Rahnasto

Abstract Top management's strategic commitment to occupational health and safety (OHS) is crucial, but the middle and frontline managers play an important role in OHS management at the tactical and operational levels. The managers' commitment can be supported by defining their OHS responsibilities and tasks. However, practical examples of their tasks are not widely discussed. This qualitative study aims to identify the OHS management tasks at different organizational levels based on empirical findings from Finnish industrial organizations. Top management's OHS tasks focus on value judgements, goal setting, providing support, and visibly demonstrating their commitment to OHS. Middle managers develop uniform OHS procedures across the organization, and provide guidance to the frontline managers. Frontline managers monitor the daily work and identify the safety development needs for decision making. The emerged OHS tasks mostly involved technical issues, while human factor aspects were less emphasized, although they have been actively studied for some time.

Keywords Human factors · Safety management · Occupational health and safety · Top management · Middle management · Frontline management

1 Introduction

The management function is typically divided into three levels [1]. Top management is responsible for identifying and establishing overall objectives and strategies in relation to the organization's environment. Middle management is responsible

S. Tappura (✉) · J. Kivistö-Rahnasto
Department of Industrial Management, Center for Safety Management and Engineering, Tampere University of Technology, P.O. Box 541, 33101 Tampere, Finland
e-mail: sari.tappura@tut.fi

A.-M. Teperi
Finnish Institute of Occupational Health, Safety Solutions, Töölöntullinkatu 8, 00250 Helsinki, Finland

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for organizing and managing activities for the implementation of these objectives and strategies. Frontline management coordinates and supervises the actual work. In this study, management is studied from the perspective of a manager's formal position in an organization. The position provides the manager with the resources to lead, as well as the authority and positional control over his/her subordinates [2]. Based on their formal authority, managers represent their employer in relation to occupational health and safety (OHS) legislation [3]. Nevertheless, managerial authority is seldom a sufficient basis for gaining the subordinates' commitment to safety, since success as a manager also involves leadership [1, 4], and an understanding of human factors (HF) to improve safety [5]. Thus, striking a balance among all these work roles and demands is essential. The importance of managing and order increases when an organization becomes larger, while the importance of leadership, flexibility, and resilience increases when the external environment of an organization becomes more uncertain and dynamic [1, 2, 6]. In this study, managing refers to both management and leadership, and understanding the mastery of HF in these roles.

The intended outcomes of OHS management are to prevent work-related injury and ill health [7]. Managing OHS includes establishing OHS policies, objectives, processes, and procedures to achieve the objectives [7], also mentioned as principal levels of safety management in general [8, 9]. In any case, many problems associated with risk and safety in organizations should be addressed more from a human and organizational perspective, rather than a technological perspective [10, 11], but a balanced approach to safety management is needed [12]. Human and organizational influences on safety have been underestimated in traditional safety models and safety management practices [12, 13]. This study, however, departs from an organizational and contextual perspective, and thus, adds to the current safety research.

The OHS management concept involves the establishment, implementation, and follow-up of organizational policies, acceptance criteria, and goals related to safety and health [14]. Moreover, management's responsibility and accountability for OHS are often seen as integral to OHS excellence in organizations [7, 15, 16]. The managers' active role is commonly considered one of the key elements of successful safety management, climate, and culture [7, 15, 17, 18]. Through their actions and examples, managers can support the employees' behaviors and activities in matters of safety.

Top management's strategic commitment to safety is crucial, but the middle and frontline managers also play an important role in managing occupational safety at the tactical and operational levels [19–21]. Top management has the power to delegate authority and provide resources within the organization [7]. It should define the managers' OHS responsibilities, and ensure their awareness and competence in relation to OHS, as well as the clarity of the OHS responsibilities between different organizational levels [7]. However, upper management often ignores its duty to manage OHS risks, and delegates issues to middle and frontline managers without providing sufficient resources, support, guidance, or monitoring of the results [22]. The same phenomenon was also found in top management's role in communicating and committing their personnel to the meaning and mastery of

HF in their organization [5]. Also, the recent studies of Conchie et al. [23] and Hardison et al. [24] identified the importance of OHS resources and the organizational support needed for managers to succeed in improving health and safety at work [23, 24]. Thus, to ensure success, organizational OHS procedures, resources, and the managers' responsibilities should be emphasized in organizations [25].

Managers' safety commitment can be defined as the extent to which they place a high priority on safety, as well as how effectively they openly communicate and act on safety issues [26]. Managers' commitment to the safety role arises from increased safety awareness, which may be induced reactively by an accident or other crisis, or proactively by a training or safety improvement program [6]. In addition, OHS management systems (e.g., OHSAS 18001:2007) presume that managers are aware of their responsibilities and have sufficient competence to carry out OHS-related tasks [7]. Hence, information is needed about the managers' OHS tasks at different organizational levels.

The paradigm of resilience, which has evolved in recent years, has been defined as a system's ability to protect the organization from harms and risks proactively, concurrently, and reactively, by preventing something bad from happening, from it becoming worse, and by recovering from it once it has happened [9, 27]. This system ability emerges especially in sustaining required operations under both expected and unexpected conditions [6, 28].

Putting resilience in practice, however, demands awareness, knowledge, and mastery of HF in safety management, to maintain and improve a favorable safety culture. This includes policies and practices at the individual-, group-, work-, and organizational levels [13, 29]. The human contribution to safety has been recognized for quite a long time [9, 30–32], however, technological and procedural orientations to safety have often dominated. The human has not been in focus [13, 28, 33], although system safety models and frameworks have changed over the decades, from technical analysis to HF, safety culture, and system analysis [6, 34].

From the management perspective, putting resilience and a mastery of HF in action demands understanding the systemic and cultural drivers of safety. Organizations and their managers have to be committed (motivated and have the resources), competent, and cognizant to force safety awareness and improvements, such as by modeling good safety practices at the workplace, as well as by providing management with enough resources to fulfil safety procedures and practices in the everyday work [9, 35]. Awareness of HF offers a crucial added value to improving the safety of services and production; however, HF competence is still weak in several technically oriented work environments, and it may take some time to raise and accept the HF viewpoint as a natural part of safety management [5, 13].

A wide variety of literature has been published on the importance of the managers' role in the successful promotion of safety and OHS. However, the practical examples of the responsibilities are not widely discussed. Managers' safety competence and commitment may be supported by defining and visualizing their practical OHS responsibilities and tasks at different organizational levels, and by evaluating whether they possess characteristics of resilience and HF mastery, which are considered valuable in improving safety. The objective of this study are: to

identify the OHS management tasks at different organizational levels; to discuss these findings in relation to the safety research in general; and to evaluate whether the characteristic of HF mastery can be discovered within the tasks. In this study, the tasks of the OHS specialists are not discussed. Based on the task identification, managers' safety competence requirements can be set at the job description and recruitment stage. Moreover, the managers' safety competence may be evaluated and developed according to the organization's safety policies.

2 Materials and Methods

This chapter discusses the managers' diverse OHS tasks based on the literature and empirical findings from Finnish industrial organizations. To chart managers' safety tasks, this study was carried out as part of a larger interview study. The study was part of a research project called "Safety Management—Managers' Safety Competence, Leadership, and Commitment," which was carried out in 2014–2015 at Tampere University of Technology and involved seven Finnish industrial organizations (Table 1). All seven organizations emphasize safety as a strategic goal and have carried out successful work to improve occupational safety. The motivation for the organizations' participation in the study arose from their need to better support managers in their safety roles to improve safety.

The results are based on thematic interviews with 52 managers at different organizational levels, including CEO, CBOs, production managers, maintenance managers, project managers, and supervisors.

The interviews were transcribed. Then, the transcriptions were thoroughly examined, and all tasks mentioned were categorized under main themes using a content analysis method and summarized in a data table. Quotations that illustrated the findings well were selected from the data. The results were reviewed and discussed in a related workshop in December 2014. The workshop participants (n = 9) were safety professionals from the participating companies and the research organization.

Table 1 Background information about the participating organizations: 2014

Company	Industry	Turnover	Number of employees
1	Oil industry	€15 billion	5,000
2	Energy production	€819 million	1,500
3	Industrial services	€640 million	7,800
4	Industrial services	€100 + million	700
5	Chemical processing	n/a	550
6	Staffing services	€12.9 million	320
7	Industrial services	n/a	200

3 Results

Based on the managers' interviews, their OHS tasks are presented by organizational level (top, middle, and frontline management) due to the differing nature of the tasks. Many different tasks emerged in the interviews. At the top management level (Table 2), the major task is to ensure that OHS is integrated into the management system and strategic plans, as well as policy and decision making. Top management monitors the OHS procedures and their adequacy in relation to established objectives and achieved results. Top management visibly demonstrates the importance of OHS by participating in OHS activities and actively communicating OHS issues, as the CEO of an industrial service organization stated, for example:

> For my part, I keep safety issues on the agenda when I meet the employees of the company. […] I opened the company safety day and talked about how we should regard safety issues. […] I organize and participate in safety walks together with the local management and supervisors.

At the middle management level (Table 3), the major OHS task is to create, maintain, and develop consistent OHS procedures according to the regulatory requirements and organizational safety policy at the department level. Middle managers disseminate the safety goals and expectations to their subordinate managers and provide support to them, as one maintenance manager cited:

> [My OHS task is] to put forward the organizational OHS objectives, to oversee and spur reaching the objectives.

The middle managers actively monitor the work environment and intervene in non-safety activities when noticed. They report the safety deficiencies and development needs to top management for decision making when they are not able to make the necessary decisions on their own. Key tasks of middle managers include emphasizing the importance of safety, and encouraging compliance with safety procedures at the department level, as some middle managers expressed:

Table 2 Major OHS tasks at top management level

Category	Example
Strategic planning	Ensure that OHS issues are integrated into the strategy and decision-making processes (e.g., goals and resources)
	Initiate OHS programs, campaigns, and cooperation
	Select qualified middle managers
Monitoring	Oversee the OHS procedures and results (e.g., OHS records and preventive activities)
Exemplariness	Act as a good example
	Participate in OHS activities (e.g., safety walks and training)
Support	Give resources and support to the middle and frontline managers in their OHS activities
Communication	Communicate actively on OHS issues
	Keep OHS issues on the agenda in meetings and events

Table 3 Major OHS tasks at middle management (department) level

Category	Example
Tactical planning	Recognize the regulatory safety requirement and ensure their fulfillment (e.g., controlling the risks of the work environment)
	Disseminate organizational safety goals and expectations
	Select qualified frontline managers
	Ensure the functioning of the orientation procedure
Consistency	Develop and follow uniform OHS procedures across the organization
	Encourage safety compliance among subordinate managers
Monitoring	Monitor the safety of work and the work environment
	Control the compliance with safety procedures
	Intervene in undesirable activities
	Remedy or report safety development needs
	Oversee the realization of corrective actions
Exemplariness	Act according to the safety procedures and instructions
	Participate in safety activities
Support	Encourage safe behavior
	Support frontline managers' safety work (e.g., resources, assistance)
Communication	Communicate safety issues
	Emphasize the importance of safety

> My most important task is to make sure that my subordinate managers and their subordinates react correctly to the safety issues.
>
> I have a habit of regularly commenting on the safety issues in my own department.
>
> I make sure that the most serious situations are reviewed and a safety quarter meeting is held.

The frontline managers' and supervisors' role is essential for the operational OHS management and day-to-day decisions in relation to safety (Table 4). They monitor the daily work, and when necessary, intervene in non-safety activities, such as conflicts in the workplace:

> I have had to intervene in the conflicting chemistry between two individuals and had to resolve it.

The frontline managers typically take care of the induction and evaluate the employees' ability to carry out work assignments as follows:

> I make sure that all the employees have been initiated to operate all the devices in the working area.
>
> I check the employee's competence and work ability against the work assignment.

In addition to monitoring and controlling the daily work, frontline managers report safety development needs to their superiors when they are not able to take the necessary measures on their own, as one supervisor stated:

Table 4 Major OHS tasks at frontline management level

Category	Example
Operational planning	Implement safe operations
	Ensure the successful induction of employees to the work and work environment
	Ensure the employees' suitability to the work assignment
Monitoring	Monitor the safety of the work and work environment
	Control the compliance to safety instructions
	Take care of the tidiness and order at the workplace
	Intervene in undesirable activities
	Report safety development needs
	Take corrective actions
Exemplariness	Act according to the safety procedures and instructions
	Participate in risk assessments with the employees
Support	Encourage safe operations
	Encourage employees to assess risks when commencing work
	Help employees in safety activities (e.g., reporting risks or incidents)
	Reward desirable safety behavior
Communication	Communicate safety issues as a part of the daily work
	Carry out development discussions
	Actively build positive interactions with the employees

> I pass on the issues which have emerged in the development discussions with the employees.

To proactively promote confidential relationships and prevent conflicts in the work community, the frontline managers also build positive interactions with the employees, as one supervisor cited:

> I have attempted to build really good dialogical connections with all my subordinates.

4 Discussion

Managerial responsibilities typically include supervising, planning, consulting, organizing, and decision making, and monitoring, controlling, coordinating, and administering activities according to the organization's objectives. The relative importance of these activities depends on the managerial position [1]. Based on their formal position, managers represent their employer in relation to OHS legislation. Managers' OHS awareness, and respectively, their commitment to OHS can be induced by enhancing the managers' own understanding of their OHS tasks and supporting managers' OHS resources [25].

In this study, OHS management tasks are identified and discussed to support managers' OHS awareness and commitment. Based on the results, managers have various OHS management tasks that differ based on the manager's organizational level. In top management, tasks such as strategic decision making and problem solving are generally emphasized [1]. Strategic decisions, including OHS, should flow downward through the lines of the organization. Top management OHS tasks include establishing OHS policies, objectives, and programs. At the top management level, their OHS tasks should focus on value judgements, goal setting, providing support, and visibly demonstrating their commitment to OHS. Furthermore, top management should define the OHS responsibilities of lower level managers, and ensure that they are aware of these responsibilities and capable of fulfilling the requirements [7]. Therefore, top management must ensure provision of the support, resources, and guidance of the OHS tasks at the middle and frontline management levels [22, 25].

Middle management's tasks are to create structures and develop procedures necessary to carry out the strategies and meet the objectives defined by top management [1]. At the middle management level, OHS tasks focus on implementing the organizational OHS policies and objectives set by top management. Middle managers play a central role in creating and maintaining uniform OHS procedures across the organization. Moreover, their tasks include the continuous follow-up and improvement of OHS and the work environment, as well as intervening in deviations. They also provide guidance and support to the frontline managers in their safety work and respond to their input.

Frontline managers' tasks typically include the actualization of the procedures and the maintenance of fluid operations [1]. Frontline managers monitor the daily operations and identify OHS deviations and development needs. OHS deficiencies and development needs are typically perceived at the operational level; therefore, it is important for information and resource needs to move upward in the organization for adequate development actions. In addition, frontline managers play a central role in building trust and positive interactions between employees to promote safe practices and to prevent conflicts in the work community.

As mentioned above, the OHS tasks mentioned by the study subjects mostly included technical and procedural issues, and stressed focusing on compliance-related safety thinking [36]. Some perceptions reflecting mastery of HF were also revealed, such as motivating, openly discussing or reporting risks and incidents, and proactively promoting confidential relationships, which are indicative of resilience-based safety thinking. The aspects of HF (and/or resilience) were not in focus in this study, although this has been the object of active safety research for quite some time [6, 28, 37, 38]. Since industrial managers at various levels are not HF professionals, they may face challenges with learning and analyzing HF in work processes and within their safety tasks. Managers at all levels (top, middle, and operational) would benefit from improving their competence and usage of tools and models, which would improve their understanding and identification of HF contributing to their daily work operations and routines, as well as to operational mishaps such as incidents [29].

The scientific contribution of this study is based on its explorative nature. It widens the understanding about managers' OHS tasks and highlights managers' need for support for the successful execution of these tasks. The results provide guidance for organizations, managers, and safety professionals towards defining the managers' OHS tasks, as well as further widening the scope of OHS tasks to meet the latest findings from OHS and safety research. The definition is important in order to allocate resources and define the competence requirements for the managers' OHS work. Moreover, it will help in providing managers with the necessary support and tools for OHS management, including HF aspects, such as promoting safety motivation or understanding operative personnel's complying or failing to comply with safety procedures. Improving the quality and consistency of OHS management among organizations requires greater emphasis on the managers' OHS work and organizational-specific task definitions. The definitions may be utilized at the basic training phase (technical academies and universities), recruitment stages, in competence evaluations, when designing and improving OHS management systems for the organization, and in human resource development, as well as in assessments of managers' resources and work stresses.

Further research could proceed with defining more accurately the safety tasks that top, middle, and frontline managers consider the most efficient for creating and improving safety, and which commit the whole organization to a favorable safety culture, to meet the ideas of resilience.

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References

1. Yukl, G.: Leadership in Organizations, 7th edn. Pearson Education Inc., New Jersey (2010)
2. Grint, K.: Leadership: Limits and Possibilities. Palmgrave Macmillan, Houndmills, Basingstoke Hampshire, New York (2005)
3. 2002/738 Occupational Safety and Health Act (in Finnish). https://www.finlex.fi/fi/laki/ajantasa/2002/20020738 (2002)
4. Tappura, S., Nenonen, N.: Safety leadership competence and organizational safety performance. In: Arezes, P., Carvalho, P. (eds.) Advances in Safety Management and Human Factors. Advances in Human Factors and Ergonomics, vol. 10, Section 3, pp. 4330–4339. Proceedings of the 5th International Conference on Applied Human Factors and Ergonomics (AHFE), Kraków, Poland (2014)
5. Teperi, A.-M., Leppänen, A.: Managers' conceptions regarding human factors in air traffic management and in airport operations. Saf. Sci. **49**, 438–449 (2011)
6. Hollnagel, E., Woods, D.D., Leveson, N. (eds.): Resilience Engineering: Concepts and Precepts. Ashgate Publishing Ltd, Hampshire (2006)
7. OHSAS 18001:2007. Occupational Health and Safety Management Systems—Requirements. OHSAS Project Group BSI, London (2007)
8. Dekani, A., Wiener, E.L.: The four P's of flight deck operation. In: Johnson, N., McDonald, N., Fuller, R. (eds.) Aviation Psychology in Practice. Avebury Technical, Aldershot (1994)

9. Reason, J.: The Human Contribution. Unsafe Acts, Accidents and Heroic Recoveries. Ashgate Publishing Ltd., Farnham (2008)
10. Lee, T., Harrison, K.: Assessing safety culture in nuclear power stations. Saf. Sci. **34**, 61–97 (2000)
11. Hollnagel, E.: Barriers and Accident Prevention. Ashgate Publishing Limited, Aldershot (2004)
12. Rollenhagen, C.: Can focus on safety culture become an excuse for not rethinking design of technology? Saf. Sci. **48**(2), 268–278 (2010)
13. Teperi, A.-M.: Improving the Mastery of Human Factors in a Safety Critical ATM Organization Cognitive Science. Doctoral dissertation, Institute of Behavioural Sciences, University of Helsinki, Finland (2012)
14. Kjéllen, U.: Prevention of Accidents Through Experience Feedback. CRC Press, London (2000)
15. Biggs, S.E., Banks, T.D., Davey, J.D., Freeman, J.E.: Safety leaders' perceptions of safety culture in a large Australasian construction organization. Saf. Sci. **52**, 3–12 (2013)
16. Petersen, D.: The barriers to safety excellence. Occup. Hazards **62**(12), 37–42 (2000)
17. Fernández-Muñiz, B., Montes-Peón, J., Vázquez-Ordás, C.: Safety culture: analysis of the causal relationships between its key dimensions. J. Saf. Res **38**(6), 627–641 (2007)
18. Hale, A.R., Guldenmund, R.F., van Loenhout, P.L.C.H., Oh, J.I.H.: Evaluating safety management and culture interventions to improve safety: effective intervention strategies. Saf. Sci. **48**(8), 1026–1035 (2010)
19. Flin, R., Yule, S.: Leadership for safety: industrial experience. Qual. Saf. Health Care **13**(2), 45–51 (2004)
20. Vink, P., Imada, A.S., Zink, K.J.: Defining stakeholder involvement in participatory design processes. Appl. Ergon. **39**, 519–526 (2008)
21. Leveson, N.: Applying system thinking to analyze and learn from events. Saf. Sci. **49**, 55–64 (2011)
22. Frick, K.: Work environment dialogue in a Swedish Municipality—strengths and limits of the Nordic work environment model. Nordic J. Working Life Stud. **3**(1), 69–93 (2013)
23. Conchie, S.M., Moon, S., Duncan, M.: Supervisors' engagement in safety leadership: factors that help and hinder. Saf. Sci. **51**, 109–117 (2013)
24. Hardison, D., Behm, M., Hallowell, M.R., Fonooni, H.: Identifying construction supervisor competencies for effective site safety. Saf. Sci. **65**, 45–53 (2014)
25. Tappura, S., Syvänen, S., Saarela, K.L.: Challenges and needs for support in managing occupational health and safety from managers' viewpoints. Nordic J. Working Life Stud. **4**(3), 31–51 (2014)
26. Neal, A., Griffin, M.: Safety climate and safety at work. In: Barling, J., Frone, M.R. (eds.) The Psychology of Workplace Safety, pp 15–34. American Psychological Association, xi, Washington, DC (2004)
27. Westrum, R.: Resilience Typology. In: Hollnagel, E., Woods, D., Leveson, N. (eds.) Resilience Engineering: Concepts and Precepts. Ashgate Publishing, Aldershot (2006)
28. Hollnagel, E.: ETTO-Principle, Efficiency Thoroughness Trade Off. Why Things Go Right Sometimes Go Wrong. Ashgate Publishing Ltd, Farnham, Surrey (2009)
29. Teperi, A.-M., Norros, L., Leppänen, A.: Application of the HF tool in the air traffic management organization. Saf. Sci. **75**, 23–33 (2015)
30. Reason, J.: Managing the Risks of Organizational Accidents. Ashgate Publishing Ltd., Aldershot (1997)
31. Dekker, S.: The Field Guide to Human Error Investigations. Ashgate Publishing Ltd., Aldeshot (2002)
32. Dekker, S.: Just Culture. Balancing Safety and Accountability. Ashgate Publishing Ltd, Aldershot (2007)
33. Kirwan, B.: An overview of a nuclear reprocessing plant human factors programme. Appl. Ergon. **34**, 441–452 (2003)

34. Hale, A.R., Hovden, J.: Management and culture: the third age of safety. A review of approaches to organizational aspects of safety, health and environment. In: Feyer, A., Williamson, A. (eds.) Occupational Injury: Risk, Prevention and Intervention, pp. 129–265. Taylor & Francis, London (1998)
35. Minzberg, H.: Mintzberg on Management: Inside our Strange World of Organizations. The Free Press, New York (1989)
36. Hale, A.R., Borys, D.: Working to rule, or working safely? Part 1: A state of the art review. Saf. Sci. **55**, 207–221 (2013)
37. Wilson, J.R.: Fundamentals of ergonomics in theory and practice. Appl. Ergon. **31**, 557–567 (2000)
38. Weick, K.E., Sutcliffe, K.M.: Managing the Unexpected. Resilient Performance in an Age of Uncertainty, 2nd edn. Jossey-Bass, John Wiley & Sons, Inc., San Francisco (2007)

Making Relationships Matter: Director Interlocks and Fortune 500 Performance, 1996–2007

Mark Abdollahian, John Thomas, Zining Yang and Rita Chiang

Abstract Board memberships are critical to Fortune 500 performance, providing access to sectoral knowledge or resources, management expertise, and capital. How can companies strategically target new directorships to maximize financial returns? We explore how director interlocks impact Fortune 500 ranking performance from 1996 to 2007, combining traditional financial indicators with board membership composition through social network analysis. We benchmark how key business drivers influence Fortune ranking, and then employ social network metrics of centrality and structure to show how interlocking directorships affect outcomes. We then subsequently perform dynamic panel regression techniques to estimate financial impact across sectors. Strategically selecting board memberships has a large potential return on investment, different sectors and ranking level, which can impact firms' bottom lines by billions of dollars and tens of Fortune 500 ranking points.

Keyword Social network analysis · Fortune 500 · Board membership · Director interlocks · Corporate performance · Return on investment

M. Abdollahian · Z. Yang (✉)
Claremont Graduate University, Claremont, CA 91711, USA
e-mail: zyang@lasierra.edu; Zining.yang@gmail.com

M. Abdollahian
e-mail: mark.abdollahian@cgu.edu

J. Thomas · Z. Yang
La Sierra University, Riverside, CA 92505, USA
e-mail: jthomas@lasierra.edu

R. Chiang
Palo Alto University, Palo Alto, CA 94304, USA
e-mail: rchiang@paloaltou.edu

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1 Introduction

Conventional business wisdom states that relationships matter, but exactly how do they matter? Board memberships are critical to large cap success, providing access to sectoral knowledge or resources, management expertise, oversight and capital. From 1996 to 2003, U.S. Airways Group expanded its board by 40 % while it's Fortune ranking drops 88 points due to dismal revenue performance. How can companies strategically target new directorships to maximize returns and hopefully avoid US Airways misfortune? How much impact does directorships have? The New York Times has 10 direct connections to other firms via board members since 1999, but its ranking remains below 450 consistently. Revenues or relationships; is it what you know or who you know? What, if any, are the actionable, targeted strategies for firms that maximize director returns? These are the questions we seek to address.

In business, interlocking directorships among corporations has spawned a vast amount of theory and research, ranging from how and why one individual sits on another company's board, to the causes and consequences of corporate practices and governance structures. From an agency perspective, directors shape corporate organizational behavior as well as impact market performance—creating strategic alliances [1, 2], supply chain management [3, 4], access to capital resources [4–6], and performing independent oversight functions to protect shareholder interests [7–10]. Starting with the seminal work [11] on the nature of US corporate elite, Useem [12] and Mintz and Schwartz [13] employed quantitative approaches based on networks of overlapping directorships to explore the decision making power of such networks. Tracing the development of corporate networks, Mirzuchi [14] finds US interlock networks consistently connected in under five steps, less than conventional 'six degrees of separation.' Davis et al. [8] also explore the 'small world' phenomena of corporate elites, showing how interlocks are resilient to macroeconomic and micro market changes. Another central question is the interlock-profit relationship, where researchers such as Baysinger and Butler [15] find a positive effect of interlocks on profitability while others such as Richardson [16] show the opposite. Mizruchi [14] provides an overview of interlocks research, focusing on director memberships from a cooptation, monitoring, legitimacy, and career advancement perspectives to interlocks as causal mechanisms for corporate control, M&A and investment activity or poison pill tactics.

Our goal is to explore how Fortune 500 ranking performance is impacted by director interlocks from 1996 to 2007. As traditional financial indicators are key corporate performance indicators, we seek to understand the additional impact that interlocks provide from an SNA perspective. We econometrically benchmark key business drivers such as revenues, profits, GPM, total assets and liabilities that influence Fortune ranking, and then employ social network metrics of centrality to show how interlocking directorships affect ranking outcomes over time. We then subsequently perform empirical assessments using panel regression techniques to

estimate the various impacts of business and network metrics on the Fortune 500 ranking over time.

We do this from two different perspectives: first, how connectivity for the entire network of board memberships has changed over time; and second, how firm board composition affects performance. Empirical result adds to insights toward formulating additional criteria, and the order of their importance, for developing a firm's interlock strategy. Our approach is different from various previous work studies in that we not only empirically assess overall Fortune 500 ranking performance, but we also look at how interlock strategy can vary depending on firm ranking level measured by quintiles, as well as cross sectoral effects. This approach helps to identify the conditions under which interlocking director networks either propel or impede a company's ranking performance over time to develop board selection criteria.

2 Past Work on Directorship Linkages

Boards are seen as an instrument for a firm to deal with its environment [17], as corporate governance bodies that provide access to information or capital resources. Directors possess expert knowledge and build up informal/formal connections between firms. Despite different rationales and effects for interlocking directorates, it is agreed that interlocks are associated with diverse corporate behavior.

Many scholars start with the assumption that access to resources simulates interlock formation. This approach points out that collusion, cooption, career development, legitimacy, and social cohesion are amongst the reasons that interlocks form. Davis et al. [8] focus on the sociology of corporate elite and point out social cohesion among 'power elites' as described by Mills [11] as a key factor in interlock formation. They examine the degree of stability in the structure of the corporate elite network in the US during the 1990s and find that the level of connectivity among the fortune 500 is remarkably consistent over time. Palmer [6] suggests that diversified boards are more likely than others to facilitate formal coordination, such as profitable strategic alliances or joint ventures. Kenis and Knoke [18] mention the importance of information flows among business and investigate how those flows may affect corporate strategy. Knoke, Yang and Granados [19] used network metrics to study the topic of strategic alliances in the global information sector and how changing ties among core firms generates a more differentiated strategic alliance network. Hillman and Dalziel [20] view interlocking corporate directorates as a gateway to accessing more and higher quality of information that flows through entire Fortune 500 network. Therefore, interlocking directorates can increase information quality, reduce uncertainty and implicitly drive profitability.

While these perspectives focus on the reasons for interlocking directorates, the consequences of interlocks are also widely debated. Board memberships are a means for corporate control through strategic alliances, merger and acquisition activity, or oversight [21] and dominant players in corporate control [22, 23]. Profitability of interlocks is another large area, although there is little consensus on

how profitable director interlocks are [15, 24, 25]. Richardson [16] shows that unprofitable firms are more likely to form interlocks whereas some other scholars show a nonlinear relationship between the two. Yermack [26] uses a sample of 452 large U.S. industrial corporations between 1984 and 1991, to show that small boards are more effective. However, it is argued that directors of firms with higher growth opportunities tend to hold a greater number of directorships despite the costs the firms may incur. According to their logic, a larger board implies the existence of greater opportunity for a company albeit at a cost which we will explore below. The emphasis on board memberships as a means of communication instead of a means of corporate control views interlocks as a type of social capital which is essentially an information channel that flows through the network [27].

We empirically test the results of director performance, exploring if and how board memberships impact business outcomes, as measured by Fortune 500 ranking. Below we provide a brief introduction to understanding board memberships in different relational contexts (proximity, density, and centrality) with social network metrics that can help explain and predict rankings.

3 Interlock Metrics and Hypotheses

As opposed to traditional statistical inference, in network analysis power and the resulting control over outcomes is relational. Thus, the attributes of individual firms, such as revenue or GPM, must also be combined within the structure of connections, via director interlocks, to fully vet performance. Firms are connected to each other according to different types of dependency such as trade, information, kinship, conflict, exchange, etc. The structure of the social network determines an individual's position and status within a network. In our study, nodes are fortune companies while the links show the strength of director interlocks due to sharing of the same board member(s). One reason for the proliferation of network techniques to studying directorate interlocks are that such network metrics can transfer into market power, alliance formation and the importance of, costs, benefits, of directorate interlocks. As traditional financial indicators are obvious key corporate performance indicators for the Fortune 500, we seek to understand how interlocks impact from a network perspective. Thus, we posit that relationships can matter, more formally as:

Hypothesis 1 Director interlocks as measured by various SNA metrics can impact fortune ranking as relationship matters affecting overall Fortune 500 performance.

Centrality measurements in network analysis quantify graph theoretic ideas about actor's prominence within a network by summarizing the structural relations among all nodes. We use two particular measures, defined by degree and harmonic

closeness metrics. Degree centrality measures the number of ties to other actors in the network. In our context, degree counts the number as well as strength of interlocks via board memberships between companies. If company A has nine directors, then that firm does not necessarily have a degree value of nine, if those directors do not sit on any other Fortune 500 boards, that company would have a degree value of zero and be isolated. If company A has nine directors and six of them sit on other fortune 500 boards, then Company A would have a degree value of six if those other directors did not sit on any other additional Fortune 500 boards.

We posit that companies with directors that have more connectivity to other Fortune 500 companies (high degree) should possess more firm specific options and opportunities, while being less dependent on other companies for access, that lead to better ranking performance. Moreover, we want to explore the change in degree, to see the additional costs or benefits for increasing director interlocks as well as the relative competitive performance of firms changing interlocks.

Hypothesis 2 The number of director interlocks (measured by degree) leads to better Fortune ranking.

Increasing degree (measured by change in degree) should have a positive impact on Fortune 500 ranking due to better firm specific information and knowledge acquisition relative to other competitors.

Closeness centrality measures the extent to which a firm is near other firms in the network. Firms that are able to reach others via shorter director interlocking paths should have better access to resources and knowledge than firms that do not. We use a specific metric of closeness centrality, Harmonic-closeness, which measures the extent to which a company is near other firms in a network, meaning how fast a company can interact with others via its interlocks. The calculation of harmonic-closeness is the inverse of the average geodesic distances between companies (geodesic distance is the length of the shortest path connecting two companies). Firms with higher harmonic-closeness scores should have faster rapid access to others within the Fortune 500, possessing comparatively more direct bargaining and exchange leverage. For example, in 2007 Apple Computer has low harmonic-closeness (123) since the company is not well connected to others. All of its 4 director interlocks, GM, Dana Corp., Google, and Walt Disney, also have low harmonic-closeness values. Thus, it takes a longer path for Apple to access everyone else within the Fortune network.

Hypothesis 3a Firms that are closer to others in the Fortune 500 (measured by harmonic-closeness) should have better ranking performance due to quicker directorate access to other firms.

Hypothesis 3b Firms that increase their closeness (measured by change in harmonic-closeness) should have better ranking performance relative to competitors due to quicker directorate access to other firms.

4 Research Design

We first collect Fortune company level business data from 1996 to 2007, then we code director interlocks to create network metrics on directors and then finally regress business variables, our director interlock metrics and the combined effects as independent variables on explaining Fortune 500 ranking. By looking at changes in ranking over time, we capture which relationships matter and identify firm specific strategies for targeting directors to increase success among America's top firms.

Our data includes all companies listed within the Fortune 500 from 1996 to 2007. These are U.S. incorporated companies including private companies and cooperatives that file 10-Ks, as well as mutual insurance companies that file with state regulators. The data spans nine business sectors: agriculture, mining, construction, transportation & utilities, wholesale, retail, finance and finally services. Since companies can enter or leave the list, our final sample includes 758 firms over 12 years, for a total N = 5078 observations due to missing data. Financial variables are collected from both assets and liability side in order to benchmark corporate performance-revenues, employees, Pretax GPM, and S&P Return—from various sources, including Mergent Online, Hoover's, and Wharton Research Data Services

To capture director interlocks, we first obtained the director names for each company. Then we coded a 500 $\times$ 500 adjacency matrix for 12 years that looked at how many common directors sat on other company's boards. For example, Company A and Company B do not share any director interlocks, so the value in the adjacency matrix is zero. However, for company C and company D, since they share 4 common directors, we coded a value of 4 for the adjacency matrix. Director interlocks indicate not only the presence, but also the strength of ties across companies if multiple members of one company sit on the board(s) of others. We then calculate four social network metrics based upon these data in three categories: centrality of a company in the network (degree and harmonic closeness), how dense director connections (clustering) and how well do companies act as a bridge to others through board remembers (brokerage). Our sample decreases to n = 2957 due to companies that are isolated with no direct connections to others in the Fortune 500 would not generate any useful network metrics.

Degree, or the number of director interlocks, shows that on average, companies have seven board members ties to other Fortune 500 members. The maximum degree value is 38 for Chase Manhattan in 1998, which of course is larger than the size the board, as this indicates that directors can sit on multiple boards and those who do bring multiple connections to a company. The change of degree between companies can be as much as 15 from the prior year, such as Citigroup which expanded its number of direct ties from eight to 23 in 1999, as well connected directors are invited on the board.

Harmonic-closeness measures the extent to which a company is near all other firms, indicating the speed a company can connect with others. Higher numbers are associated with companies connected to other companies by many short, direct interlocks without a lot of intermediaries. On average, companies in the Fortune

500 are close to 133 director paths. Harmonic-closeness is calculated relatively by year. For example, Sara Lee has the maximum harmonic-closeness (183) in 1996, but in 2007 the maximum value is 3M with the score 168. Year to year change in harmonic closeness indicates if companies are becoming closer to the rest of the Fortune 500. According to our sample, companies are actually becoming further apart by −0.59 director paths on average.

Clustering indicates the percentage extent to which companies cluster together via interlocks and how dense their direct connections are around them. A firm score of 100 % means that for all director interlocks to other companies, those other companies are also connected to each other, while a firm score of 0 % means that none of directors mutually sit on any other boards. In our sample, the density of companies' neighborhood connections is 24 % on average, such as IBM in 2004. However, clustering decreases by 1.1 % on average over time. Brokerage counts how many times this company serves as a bridge or broker between two other firms. Generally, a firm bridges 53.7 different relationships on average within the Fortune 500. The maximum value is 834 for Chase Manhattan in 1998 which is well situated as a broker via director interlocks. Average change in brokerage is −2.1, which indicates that firms are also becoming less of a broker over time.

We employ a fixed effects estimation approach as our data is for Fortune 500 companies over 12 years. The fixed effects approach allows us to capture company variations over time. We perform three econometric models, first benchmarking our business variables on Fortune ranking, then regressing our network metrics on ranking and finally looking at their combined effects, comparing and contrasting the explained variance and coefficients.

5 Results

Table 1 shows that average number of director interlocks measured by degree has decreased by a third from 1996 to 2007, indicating that companies are either less interconnected or perhaps companies are connecting to other companies outside of the Fortune 500. Similar changes can be seen for harmonic-closeness at a 9 % decrease. We also looked at a non-firm specific variable, density, as the overall measure of how dense the Fortune 500 is connected each year. Measured by the actual number of connections divided by all possible, the connectivity of the Fortune 500 is quite low, starting at 1.6 % and decreasing by 30 % over time to only 1.1 % in 2007. Likewise, both the clustering coefficient and brokerage also decrease dramatically at 38 and 54 % respectively.

One possible explanation for decreasing connectivity could be the flurry of merger and acquisition activity in the late 1990s. However, even with this consolidation, the Fortune 500 is less interconnected to each other through director interlocks. Contrary to early arguments on the consolidation of elite corporate power, here our network metrics seem to show the opposite, increasing the diversity of corporate interlocks over time. Another possible explanation is that Fortune 500

Table 1 Fortune 500 interlock trends, 1996–2007

Year	Degree	Harmonic-closeness	Density (%)	Cluster coefficient (%)	Brokerage
1996	8.8	138	1.6	29.3	71
1997	8.6	139	1.6	28.1	67
1998	8.5	141	1.6	26.3	69
1999	8.5	139	1.6	26.8	69
2000	8.1	136	1.5	27.1	62
2001	7.6	134	1.4	25.9	54
2002	7.7	136	1.5	25.2	53
2003	7.3	132	1.4	25.0	49
2004	7.1	132	1.3	24.6	48
2005	6.4	126	1.2	21.5	39
2006	5.7	119	1.0	19.5	30
2007	5.9	126	1.1	18.3	33
96–07 change (%)	−33	−9	−30	−38	−54

firms are connecting more to international companies not listed on the Fortune 500, tracking increasing globalization.

Table 2 reports the fixed effects regression results on ranking, with lower scores indicating better ranking performance. Several variables are log transformed to correct for heteroskedasticity, nonlinearities and outliers.

Model 1 has financial variables only, including revenues, number of employees, pre-tax GPM and market return on increasing or decreasing Fortune 500 ranking. High revenue performance is significant and positively related to better ranking. Similarly, we see that size of the company also has a significant impact on ranking. Growth in GPM may improve ranking minimally, while pretax GPM can cause harm to companies. S&P return has the largest effect among all financial variables in the model, significantly impacting the ranking of companies. The within R^2 from the mean-deviated regression on the transformed data indicates 37.94 % of the variance is explained by Model 1, using financial variables only.

In Model 2, we regress only the network variables to see the impact of director interlocks on ranking alone. We focus on centrality measures including degree, harmonic closeness, and change of harmonic closeness. Those network variables are good indicators on how well directors are positioned in the network, in terms of the number of connections, and the shortest path to reach others. Overall we see that director interlocks, as measured through our various social network metrics do impact ranking performance as postulated in Hypothesis 1. Relationship alone explains 11.03 % of the ranking outcome, approximately 30 % as powerful as

Table 2 Fixed effects estimation results on Fortune 500 ranking

Ranking	Model 1	Model 2	Model 3
Revenue	−79.2235*** (2.3222)		−71.8754*** (3.2710)
Employee	−25.4870*** (2.5712)		−17.8760*** (3.6058)
GPM	0.4639*** (0.0735)		0.2787* (0.1233)
Return	−5480.2181*** (1080.3409)		−6239.0127*** (1417.6193)
Degree		−1.6440*** (0.3572)	−1.9717*** (0.3160)
Closeness		−39.2769*** (2.5485)	0.5119 (2.7158)
d.Closeness		4.7150*** (0.9326)	0.7825 (0.8113)
_cons	505.4674*** (7.3871)	368.8998*** (9.1649)	468.6806*** (11.4571)
N	4471	2647	2221
Within R^2	0.3794	0.1103	0.4009
Between R^2	0.7892	0.0753	0.8417
Overall R^2	0.7643	0.0704	0.8074
F	583.7226	85.7524	165.9732

Standard errors in parentheses. $^{*}p < 0.05$, $^{**}p < 0.01$, $^{***}p < 0.001$

financial variables alone. More specifically, degree is both negative and significant, indicating that for each director interlock, firms with higher connectivity have higher ranking. Harmonic closeness is also significant, with much larger impact than degree. Change in harmonic closeness is also significant, but interestingly positive, indicating that changes cost ranking points on average. This surprising finding shows that while efficiency within the Fortune 500 is beneficial, there may be a cost for increasing efficiency.

The last column shows regression result with both financial variables and social network variables in Model 3. The impact of all financial variables and degree centrality remain the same, with coefficients in the same direction and similar magnitude as Model 1 and 2. Closeness centrality measures become insignificant, as the effects are washed out by the combined impact of other variables. Model fit is superior compared to the first two models, with 40.09 % of variance explained by all variables. This result confirms that financial variables still significant impact Fortune 500 ranking even when director interlock taken into consideration. In addition, relationship between board members also matter, as more connections are likely to result in higher ranking. Ranking outcome is better explained with board member relationship considered than financial performance alone.

6 Conclusion

In exploring how board memberships matter, we looked at the Fortune 500 from two different perspectives: first, how connectivity for the entire network of board memberships has changed over time; and second, how firm board composition affects performance. Empirical result reveals insights toward formulating additional criteria, and the order of their importance, for developing a firm's interlock strategy.

Contrary to Davis et al. [8] and others, we find that the overall connectivity of the Fortune 500 actually declined between 1996 and 2007. The number of interlocks decreased by 33 %, the density of all interlocks reduced by 30 %, mutual interlocks declined by 38 % and the number of times firms serve as brokers by dropped by over 50 %. While the Fortune 500 could be increasing their connectivity to other companies outside our sample, perhaps more to independent directors, the Fortune 1000 or even global companies, our results suggest increasing corporate interlock diversity and de-concentration of past elite power networks.

Key business drivers are important to Fortune success, accounting for over 37 % of ranking performance. When exploring the effects of interlocks only, we found that our interlock metrics can significantly alter outcomes, for better or worse, accounting for approximately 11 % of performance success. The empirical results suggest that most of the time traditional performance metrics matter and at the same time of board member relationships impact business success. As shown by our results that degree is positively related to performance, but harmonic closeness does not matter as much. It is not how fast you can reach other people in the network, but the number of connections that produces results.

This work is just a start to increasing the explanatory power of contemporary directorate interlocks. As our results are for the Fortune 500 only, we are reluctant to generalize specific inferences to privately held companies, the Global 1000, and those outside the Fortune 500. However, we do know that interlocks can and do make a difference. Thus the challenge for today's Fortune 500 boards, shareholders and executives is to realize the costs and reap the benefits of how relationships can matter. Besides increasing the sample size, content and longer time series for companies, we would suggest additional analysis with other variables, such as macro-economic indicators, merger and acquisition activity, strategic alliances and corporate governance indicators to expand the interplay between business performance and board memberships. In addition, other network metrics including more centrality measures and clustering can potentially be tested in future models.

References

1. Gerlach, M.L.: Alliance Capitalism: The Social Organization of Japanese Business. Berkeley University Press, Berkeley (1992)
2. Gulati, R.: Social structure and alliance formation patters: a longitudinal analysis. Adm. Sci. Q. **40**, 619–652 (1995)

3. Borgatti, S., Li, X.: On social network analysis in a supply chain context. J. Supply Chain Manag. **45**(2), 5–22 (2009)
4. Pellerin, R., Leger, P., Babin, G.: The impact of board interlocks on the diffusion of enterprise resource planning systems. Int. J. Netw. Virtual Organ. **4**(4), 402–412 (2007)
5. Caswell, J.A.: An institutional perspective on corporate control and the network of interlocking directorates. J. Econ Iss. **18**, 619–629 (1984)
6. Palmer, D.: Broken ties: interlocking directorates and intercorporate coordination. Adm. Sci. Q. **28**(1), 40–55 (1983)
7. Davis, G.: Corporate elite networks and governance changes in the 1980s. Am. J. Sociol. **103** (1), 1–37 (1997)
8. Davis, G., Yoo, M., Baker, W.: The small world of American Corporate Elite, 1982-2001. Strat. Organ. **1**, 301–326 (2003)
9. Hermalin, B., Weisbach, M.: Boards of directors as an endogenously determined institution: a survey of the economic literature. Econ. Policy Rev. **9**(1), 7–26 (2003)
10. Zajac, E., Westphal, J.: Director reputation, CEO-board power and the dynamics of board interlocks. Adm. Sci. Q. **41**, 507–529 (1996)
11. Mills, C.W.: The Power Elite. Oxford University Press, New York (1956)
12. Useem, M.: The Inner Circle. Oxford University Press, New York (1984)
13. Mintz, B., Schwartz, M.: The Power Structure of American Business. University of Chicago Press, Chicago (1985)
14. Mizruchi, M.: What do interlocks do? An analysis, critique, and assessment of research on interlocking directorates. Annu. Rev. Sociol. **22**, 271–298 (1996)
15. Baysinger, B., Butler, H.: Corporate governance and the board of directors: illegal networks in heavy electrical equipment Industry. J. L. Econ. Org. **1**, 101–124 (1980)
16. Richardson, R.: Directorship interlocks and corporate profitability. Adm. Sci. Q. **32**, 367–386 (1987)
17. Pfeffer, J.: Size and composition of corporate board of directors: the organization and its environment. Adm. Sci. Q. **17**(2), 218–228 (1972)
18. Kenis, P., Knoke, D.: How organizational field networks shape interorganizational tie-formation rates. Acad. Manag. Rev. **27**(2), 275–293 (2002)
19. Knoke, D., Yang, S., Grandos, J.: Dynamics of strategic alliance networks in the global information sector, 1989–2000. In: the Standing Working Group for Business Network Research "The Dynamics of Networks" 18th EGOS Colloquium, Barcelona, Spain (2002)
20. Hillman, A., Dalziel, T.: Boards of directors and firm performance: integrating agency and resource dependence perspective. Acad. Manag. Rev. **28**(3), 383–396 (2003)
21. Mariolis, P.: Interlocking directorates and control of corporations: the theory of bank control. Soc. Sci. Q. **56**, 425–439 (1975)
22. Herman, E.S.: Corporate Control, Corporate Power. Cambridge University Press, New York (1981)
23. Mace, M.L.: Directors: Myth and Reality. Harvard Business School, Boston (1971)
24. Fligstein, N., Brantley, P.: Bank control, owner control, or organizational dynamics: who controls the large modern corporation? Am. J. Sociol. **98**, 280–307 (1992)
25. Meeusen, W., Cuyvers, L.: The interaction between interlocking directorships and the economic behavior of companies. In: Stokman, F.N., Ziegler, R., Scott, J. (eds.) Networks of Corporate Power, pp. 45–72. Cambridge, England: Polity (1985)
26. Yermack, D.: Higher valuation of companies with a small board of directors. J. Financ. Econ. **40**, 185–211 (1996)
27. Davis, G.: Agents without principles? The spread of the poison pill through the intercorporate network. Adm. Sci. Q. **36**, 583–613 (1991)

Part XX
Leadership Style and Management System

Contemporary Labour and Human Resources Management as Seen by the Production Sector And The Judiciary Employees

Janusz Rymaniak

Abstract The paper present the contemporary model of work designing, reflecting the causes and directions of labour evolution. The Author also discusses the practices of human resources management. The empirical part of the paper presents the methodology which accounts for the actual state of affairs and the state expected by the employees. The results of the pilot studies conducted in Polish companies and courts have shown a high level and differentiation of employees adaptivity. They suggest the need to engage in sector-focused research in order to create adequate solutions and toolboxes for human resources management

Keywords Work design · Work management · Human resources management practices · Human resources management

1 Introduction

Globalisation processes and fast technical progress lead to changes in the area of labour. Due to the work breakdown, the boundaries between tasks and activities are becoming more and more blurred, increased by the rising level of team work autonomization, rewarding for cooperation and intraorganizational network-based concepts. The market competition forces cost-effectiveness, which leads to, inter alia, professional career short-termness and an increase in market specialization via outsourcing various corporate functions [1]. Thus obtained performance of the production sector companies enhances the impression of inefficiency of the non-production sector functioning. This includes the judicature which according to many people exemplifies low efficiency of public institutions functioning.

One way of action is to research the subjective reality of the organizations, which is created by the employees' opinions. Pilot studies were initiated, aiming at obtaining preliminary information regarding answers to the research questions:

J. Rymaniak (✉)
WSB University in Gdańsk, Ul. Grunwaldzka 238, 80-266 Gdańsk, Poland
e-mail: rymaniakjanusz3@wp.pl

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- What is the actual state of affairs and the employees' expectations regarding the work they perform in businesses and in courts?
- Which HR management practices should result in improving the efficiency of courts functioning?
- What dimensions of changes are proposed by the employees as relevant for courts functioning?

Answers to these questions will make it possible to specify the expected directions of changes proposed on the basis of the employees' professional experience.

2 Research Problems

2.1 Job Characteristics

Continuous and variable transformations in the area of labour must be accounted for in theoretical solutions of job design. One of the search areas is the integrated model concept, proposed by theoreticians in the form of job archetypes since the mid-90s of the 21st century. In this area, four approaches are distinguished, based on different assumptions and aimed at obtaining various effects. These are specified as mechanistic, motivational, perceptual and biological, creating the framework for the interdisciplinary perspective of design [2]. The researchers' studies resulted in more and more complex models containing many different characteristics considered to be relevant. This study takes into account the current theoretical proposals regarding the factors and categories, obtaining five categories: task, physical, knowledge, social, and additional characteristics of jobs [3]. These are shown in Table 1.

The task category contains JCM Oldham-Hackman characteristics, i.e. elements specifying the essence of the job itself. The model comprises the first three characteristics considered by the Authors as fundamental (Task Significance, Task Identity and Task Variety) and Autonomy and Feedback as the characteristics of perceiving the work management conditions. Since the mid-70s, the presented category has been the basic construct of work design and the fundamental basis for developing solutions in the area of intrinsic motivation [4].

Historically, one of the oldest categories is physical characteristics, as work always required that employees should make a physical effort. Nowadays, as a result of technical progress, especially mechanization, machinization, automation and robotization processes, the physical aspect of this category has been gradually becoming less important and it is being replaced by mental requirements. Thus, the employees' physiological and ergonomic adaptation is examined, and also the opinions on the role of machines and equipment [5].

Development of information technologies and information transmission capabilities has drawn the researchers' attention to the processes of obtaining and making use of knowledge. The examined characteristics were initially treated as a constituent of work complexity. They were singled out into a separate category, as

Table 1 Contemporary model of job design characteristics

Category	Name	Contents
TASK CHARACTERISTIC	Task significance	Degree of perceivable impact of the activity on life and well-being of other people
	Task identity	Performing a separated, self-contained whole
	Task variety	Requiring various capabilities and talents
	Autonomy	Level of freedom to plan and perform a task
	Feedbeck	Direct information on action efficacy
∨		
PHYSICAL CHARACTERISTICS	Work conditions	Noise, lighting, colours, congestion, etc.
	Ergonomics	Body position, configuration of tools, etc.
	Physical Requirements	Physical force use intensity level
	Psychical demands	Work configuration as physical and mental strain
	Equipment and tools	Operating complex machinery, equipment, technology
∨		
KNOWLEDGE CHARACTERISTICS	Job complexity	Diversity of tasks, knowledge and skills
	Information processing	Minding events, data monitoring and active utilisation of cognitive capacity
	Problem solving	Creating new ideas, implementation of solutions, error diagnosing and solving, creativity
	Skill variety	Extensive possibilities of skills development and use
	Specialization	Level of specialization of indispensable skills
∨		
SOCIAL CHARACTERISTICS	Social support	Receiving help from superiors and employees
	Interdependence	The extent to which employees can rely on each other
	Interaction outside organization	Communication and cooperation with persons from outside of the organization
	Feedback from others	Receiving information on their actions from other people
∨		
ADDITIONAL CHARACTERISTICS	Workday cycles	Daily time periods for performing and accounting
	Time pressure	Performance time regime as the basis
	Temporal horizon	Flexible time periods for performing and accounting
	Virtual work	Remote working using connection technology
	Skill and ability requirement	Combining the skills to perform work at different levels: simple (routine), partially complex, complex and creative

Source [3, 8, 9]

the concept of knowledge and knowledge-based economy evolved. Thus, a separate category was established, which was important for communication and technology of activities [6].

Social characteristics regard elements of internal cooperation and external interaction and cooperation, which are important in today's work processes. They constitute a concise range of pro-relationality and pro-activeness, which means that work colleagues, superiors, clients family members participate in creating a work construct, and also other sources, such as the past behaviours and experiences [7]. The Additional Characteristics, in turn, comprise various contextual aspects regarding time and space dimensions in organising the work and using the skill to combine various levels of work complexity.

2.2 Human Resource Management Practices

The specialist literature distinguishes two research approaches with regard to human resources management practices. The most common approach is the one based on the organization architecture, in which systems dedicated to various employee groups are created. Each system has a separate philosophy, policies, practices and processes being components of the HRM architecture. Each of the elements plays a different role. The HRM system philosophy refers to the guiding principles that identify and characterize the value and course of action with a concrete HRM system employees (diversified perception of groups). HRM system policies serve as guidelines and reference points for HRM-specific activities (what does the organization intend to achieve?). HRM system practices identify the activity areas and techniques so as to ensure implementation of HRM policies (how to achieve that?). The system processes, in turn, are the way to implement the HRM practices and to present the structure of application area [10]. In this view, the systems are sets of practices, and the practices are concrete techniques of action, captured in the form of procedures.

The latter approach is described as "process-oriented". It takes the form of a cause-and-effect sequence which contains the following links: planned HRM practices leading to actual practices, the implementation of which influences their perception, and the employees' reactions contributing to obtaining a given productivity level. If the management is to bring the desired organizational results, the managers must influence the beliefs, attitudes and behaviours of their employees [11, 12].

The authors of the proposed theoretical sets of human resources management practices apply two approaches. Some of the Authors, e.g. Albanese, Wood, Bryson or Guest maximize the description of the research field with a large number of parameters, whereas others, like Pfeffer or MacDufie, apply the method consisting in isolating representative parameters that are considered to be of key importance in view of the problem explanation [9].

Analysing the isolated practice models, and also their evolution, it was assumed for the research purposes that the major role is currently played by practices related

to occupational safety, remuneration, motivation, employee status development, selection, training, adaptation to changes and group thinking (being an introduction to network thinking). The above mentioned parameters were considered by employees as fundamental, both by the group of production workers and court employees [13]. Thus, an "adjusted" (Pfeffer's) Harvard concept was obtained, which was subjected to practical verification in the research study.

2.3 Dimensions of Work Transformations

The study distinguished 10 dimensions of changes connected with labour market transformations, business environment and social transformations. The first dimension is MULTISKILLS (WZL) regarding the vertical perspective (within the scope of leadership or management), the horizontal perspective (extending, deepening), specialisation enhancement (depth) or work in multi-skill teams [14]. However, the key problem is the scope of skills needed in the context of specialisation. "Performers of all tasks, who are not proficient in any of them", or a polyvalent worker or playmaker—these are the dilemmas of choice in today's practices of work organization [15].

The second dimension is INFORMATION TECHNOLOGIES (TIN). In production operations it takes the form of AMT [16]. However, in the case of work connected with obtaining, sorting, classifying, processing and producing new information, human labour is reduced or replaced with operating specialised software programs. They are increasingly autonomous or they create an interactive access for client (stakeholder), which eliminates human labour also in the administration area.

The third dimension is EMPLOYMENT FLEXIBILITY (ELS), which comprises the organizational, legal, social and individual diversity. The notion of vital importance is dividing the activity into core and other operations, and dividing employees into key and peripheral ones. For key employees, retention programmes are developed, which provides them with intraorganizational more-than-average work conditions. These are the solutions concerning the retention vs. turnover issue, aimed at retaining and development of employees and limiting their fluctuation [17]. In the Polish context, employment contract conditions are also very important, as e.g. a temporary job means worse employee welfare conditions. The next dimension is the INTERPERSONAL RISK (RYZ). This regards the phenomena taking place within organizations, such as workaholism, or stress [18] mobbing, harassment or counter-productive work behaviours [19]. The risks related to contacts with the outer world are found in the area of relationships with customers, applicants or other categories of stakeholders. These are often shown in the form of aggression, frustration, verbal abuse, physical violence, stress or occupational burnout.

IMBALANCE CRITERION (NRW) consists in infringing the workload level acceptable by a given employee. This is a result of employers' striving to organize work in such a way so that the same or even greater number of tasks is completed

by a smaller number of employees or cheaper (to decrease costs). This consists mainly in intensification of activities in time and space via application of lean management practices. Another dimension is SHORT-TERMNESS (KRT). It is shown by the desire to quickly obtain the expected result and exerting a pressure to see the effects fast. The so-called "life cycle shortening" or "getting quick results or quick money" can also be noticed in the practice of administrative institutions operation, at the expense of quality and reliability.

The next dimension is called NEGATIVE LONGEVITY OF COMPANIES (NEG). It results from analyses of duration, forms and outcomes of organizations functioning, its objective restructuring needs or bankruptcy risk. Important issues are conveyed by the dimension called EMPLOYEE SELECTION CRITERIA UNRELATED TO COMPETENCE (NIE). As a result of technical progress, labour market imbalance and assuming tertiary education as a development accelerator, it is more and more common to notice "low cost" functioning mechanisms (no need for specialist knowledge). In view of the vanishing need and the decreasing number of jobs, normal selection criteria are replaced by old-boyism, connections with people in high places, or even nepotism.

The dimension of EXCLUDING FROM COMPETION (BLK) results from blocking the access to professions (at macrolevel) or career promotion (at intraorganizational level). In public institutions, a vexatious issue is no possibility for horizontal promotion, caused by long-standing freezing of salary increases (state budget shortages). The last dimension includes "GROUP BEHAVIOUR" EFFECTS (GRP). This especially regards the development of the so-called "spirit of collectivism", via e.g. mutual encouragement, mentoring and coaching, supporting mutual help, crafting, influencing one's work colleagues, etc.

3 Research Methods and Results

3.1 Research Methods

The study was performed by means of the survey method, applying various adapted questionnaires. To research the job characteristics, the Work Design Questionnaire (WDQ) was applied. The factors are represented by single items, therefore the questionnaire contains 24 questions to make two identical sets of questions. The first one served to gather the opinions regarding the performed work, and the other to collect information on the expected levels of studied characteristics.

The second questionnaire, regarding HRM practices, contains 16 characteristics contained in eight kinds of selected practices, whereas the third questionnaire concerned the significance of the above mentioned 10 dimensions of transformations for work performed by the respondents.

The questionnaires applied the 7-grade Likert scale, where: 1 = irrelevant, 2 = no impact, 3 = rather no impact, 4 = indifferent (either yes or no), 5 = perceivable impact, 6 = significant impact, 7 = powerful impact. The questionnaires were provided with instructions on how the scale should be applied.

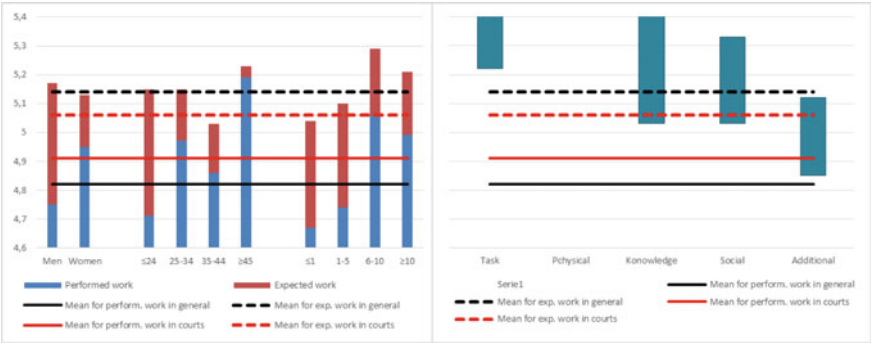
All the surveys were pilot studies. The studies regarding the job characteristics involved the population of 280 employees, and 254 questionnaires were verified as correctly completed. The internal coherence level was very high for the studied population, as Cronbach's α for the characteristics ranged from 0.89 to 0.83 regarding the work performed, and from 0.89 to 0.78 regarding the expectations. The studies involving the court employees included a population of 160 court employees, and 124 questionnaires were verified as correctly completed. The internal coherence level was also very high: Cronbach's α ranged from 0.85 to 0.74 for opinions regarding the dimensions parameters, and from 0.94 to 0.77 with regard to opinions on HRM practices.

The survey was conducted using paper rather than electronic versions of questionnaires, as research studies done in that respect have shown that "objectified" electronic versions of surveys do not involve emotions that are necessary to display experiences as well as the sources of employees' opinions and attitudes [1].

3.2 Discussion

The received results showed a small difference between the mean levels of characteristics describing the work performed and the expectations—it was only 5 % of the scale value. It is assumed that the so-called normal level of Oldham-Hackman scale amounts to 5/7 of Likert scale, i.e. 71 % of the scale value. This is because the value corresponds to the development of human psychophysiological characteristics. Therefore, there is a shift of the extensive set of work characteristics from the lower position (4.82) from the standard value 5.0 to the higher position in expectations, amounting to 5.14 %.

Figure 1 shows the development of the opinions depending on social and demographic criteria (*left-hand side*) against the directions and volumes of category changes (*right-hand side*). The categories are decisive for the significance of the characteristics in the higher level. The only exception is the physical characteristics of a job—their value remains on a low level of less than 4/7 of the scale. This confirms the decreasing significance of physical onerousness of work, as new machines, equipment and work technologies are implemented. The values of the particular categories and the mean values show that the characteristics of absolutely primary importance are those related to tasks. Their value exceeds the general mean values regarding both performed work (5.22) and expectations (5.80). The expectations in particular include an increase in the autonomy level and feedback, i.e.



Note: The inner horizontal lines show the opinions voiced by the court employees, whereas the outer lines – employees in general surveys.

Fig. 1 The actual and expected work levels as per social and demographic characteristics (*left-hand side*) compared to structural changes of work characteristics (*right-hand side*). *Note* The inner horizontal lines show the opinions voiced by the court employees, whereas the outer lines—employees in general surveys

more responsibility for employees and better quality of superior-subordinate relations. The knowledge and social category characteristics, starting at the same level (5.03), differed in terms of significance. There is a high increase in expectations regarding specialisation, skills diversification and participation in problem solving, which ends up at the level of 5.49. It is higher than in the case of expected cooperation at work (support and feedback of other persons), as social characteristics correspond to 5.33 of the expectations. The additional characteristics are only supplementary, as the expectations include a time pressure decrease by 5 % while concurrently increasing the work flexibility by 12 % of Likert scale scope. This is the level of balancing characteristics found in between the actual and expected state.

The analysis of social and demographic criteria (left-hand side, Fig. 1) shows that in terms of expectations, the growth dynamics are the strongest for women, which results in obtaining the leading opinion-forming role. A significant increase in expectations was also shown for young employees aged up to 34. Nevertheless, the highest level of opinion is seen in the case of the oldest employees, aged above 35. A similar trend can be seen when analysing the occupational experience of the respondents. A considerable increase in expectations is observed for employees with service lengths below 5 years, but the highest level is maintained definitely by those who are the most experienced professionally, with the service length above 6 years.

In the comparative studies of opinions regarding human resources management practices and work dimensions, two major conclusions have been drawn, which is shown in Fig. 2. The chequered pattern reflects five dimensions of changes that are not perceived by the respondents as relevant in courts. These are multi-skilling (the mean: 3.54), information technologies (3.97), risk (3.80), imbalance (3.20) short-termness (4.51). As shown in Fig. 2, the values of the parameters do not reach the level of the lowest value of practices, i.e. changes (4.87) and safety (5.00). This is because the court employees do not consider the elements as relevant for the

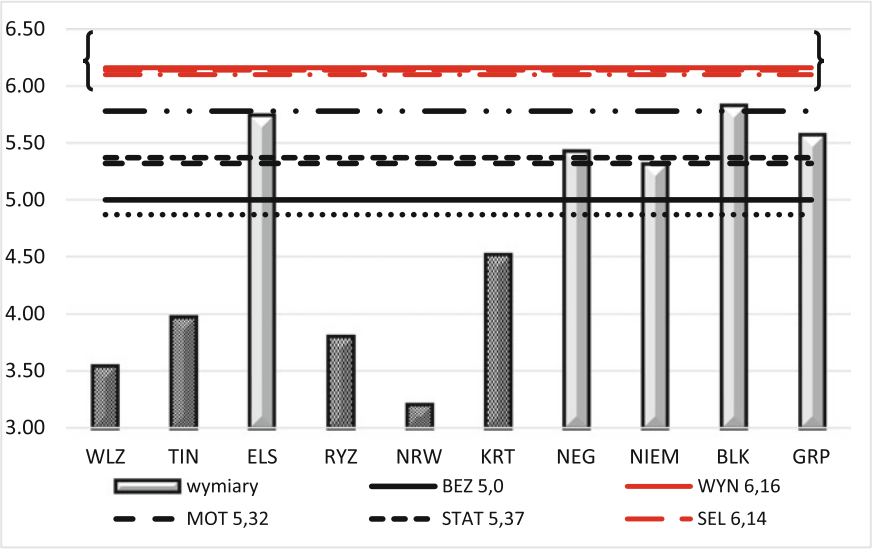


Fig. 2 HRM practices in view of work changes dimensions in the opinion of court employees

work they perform. Unification of work contents in courts does result in a need for multi-skilling [9]. Information technologies are standard for the whole area of court operations. The interpersonal risk is not perceived as a problem in view of the relatively stable employment. Imbalance in workload is not very important, as in the current work specialisation they cope with the elements of fair work breakdown (kinds of tasks, including transcribing) rather than inequality in terms of quantity (numeric).

The second conclusion results from a different area of separability. Three kinds of practices (braced in the top part of Fig. 2): remuneration, selection and group thinking show values above 6.0, i.e. above perceiving the direction of future changes by the respondents. It seems that these are the elements of central regulations in public institutions (salaries, requirements regarding recruitment). In this area, there is also no need for network thinking, which results both from the specific nature of narrow, repeatable tasks, the work breakdown and demands of the superiors.

4 Conclusions: New Work Design?

The study results have shown that the structure of job characteristics of the work performed and expected in groups of production workers and court employees is the same. The work categories in the general studies are potentially higher than the proposed ones, except the physical characteristics of work, which are practically

identical in the actual and expected dimensions. Therefore, it is not now possible to say that there is a "sector-based" human resources management in the judicature (the judicature scope falls "within the general scope—see the dotted line in Fig. 1).

The judiciary employees consider three kinds of HRM practices as absolutely most important. Apart from remuneration being the supply factor (ensuring the existence of employees and their families), the dominating ones are communication practices, rational selection, extensive and focused training and development of employees. The needs of the organization become the domain and cause of adapting the employee to the organization.

The specific nature of the work and situation of public institution employees, which has an impact on the judiciary employees' opinions, is considering half of the studied work change directions as irrelevant.

A special feature of work transformations in information-based job positions is that this is a continuous "in transition" process. Any drawn conclusions often have only a historical value the moment they have been articulated. The ever increasing level of computer technologies leads to developing new technologies of working with information. Consequently, the kinds of activities, work structure and job positions change, and employment is reduced. An analysis in terms of quality and time was made with regard to activities performed in two kinds of administration positions, based on the assumptions taken by Oxford researchers [20]. Frey and Osborne start out with three domains of human activity where computers must do the task cheaper and with a comparable quality before computers start to replace humans. They call them computerization bottlenecks. These domains are: perception and manipulation, creative intelligence and social intelligence. These three domains are then subdivided into sub domains. Perception and manipulation (into: finger dexterity, manual dexterity; cramped work spaces and/or awkward positions), creative intelligence (into: originality, fine arts) and social intelligence (into: social perceptiveness, negotiations, persuasion and assisting and caring for others). Then, using the expert method, the probability of automating the activities was estimated (labelled/classified as 1 or 0) and the vector method was applied to specify the probability. The pilot study applied a simplified method of researching job positions automation. The presented structure shows a possibility of transcribing many activities to an IT language code, as a result of which there will be a need for a rapid restructuring of tasks involved and increased universalization of their types [21]. The current scopes of tasks and time lengths needed to complete them will be totally inadequate in view of the vast range of tasks managed directly by judges via a computer system. In today's work breakdown structure at the positions of court reporter and court clerk, the task load is decreasing from 42 to 60 % of the task-based working time. Thus, the scope of tasks will need to be changed, or it will be necessary to design a flexible, "playmaker style" task-based system. Abandoning a fixed scope of tasks assigned to certain job positions will raise the working time efficiency by assigning diverse tasks that sometimes exceed the range of duties of the employee's organizational unit.

Thus, any further actions require establishing new work systems [22]. This will need answers to the following fundamental questions: To what extent is a cheaper

(temporary) employee better? To which level should we accept lower skills? Should the practices be focused on "soft" (motivation), or "hard" aspects, like justice? [23]. Also, attention should be paid to the fact that the studies show a certain "spirit of convergence", which is the essence of contemporary work transformations.

References

1. Levine, E.L., Sanchez, J.I.: Evaluating work analysis in the 21st century. Ergometrika **4**, 1–11 (2007)
2. Campion, M., Mumford, T.V., Morgeson, F.P., Nahrgang, J.D.: Work redesign: eight obstacles and opportunities. Hum. Res. Mgmt. **44**, 367–390 (2005)
3. Grant, A.M., Fried, Y., Juillerat, T.L.: Work Matters: Job Design in Classic and Contemporary Perspectives. In: Zedeck, S. (ed.) APA handbook of industrial and organizational psychology. Vol. 1: Building and developing the organization, pp. 417–453. APA, Washington (2011)
4. Hackman, J.R., Oldham, G.R.: Not what it was and not what it will be: the future of job design research. J. Org. Beh. **31**, 463–479 (2010)
5. Lis, K.: The labour market and material environment design. In: Vink, P. (ed.) Advances in Social and Organizational Factors, pp. 603–612. CRC Press Taylor & Francis Group, Boca Raton (2012)
6. Potocki, A.: Komunikacja jako proces zarządzania wiedzą. In: Potocki, A. (ed.) Komunikacja w procesach zarządzania wiedzą, pp. 33–58. Uniwersytet Ekonomiczny, Kraków (2011)
7. Kilduff, M., Brass, D.J.: Job design: a social network perpective. J. Org. Beh. **31**, 309–318 (2010)
8. Morgeson, F.P., Garza, A.S., Campion, M.A.: Work design. In: Schmitt, N., Highhouse, S. (eds.) Handbook of psychology: Industrial and organizational psychology. 2 edn., vol. 12, pp. 525–559. Hoboken, John Wiley & Sons, New York (2012)
9. Rymaniak, J., Surmacz, B.: Współczesna praca a praktyki zarządzania zasobami ludzkimi w opiniach pracowników sądownictwa. In: Magier- Łakomy, E. (ed.) Potencjał kulturowy i społeczny oraz zasoby ludzkie w procesach zarządzania, pp. 133–148. WSB Gdańsk, CeDeWu Warszawa (2015)
10. Kepes, S., Delery, J.E.: HRM systems and the problem of internal fits. In: Boxall, P., Purcell, J., Wright, P. (eds.) The Oxford Handbook of Human Resource Management, pp. 385–404. Oxford University Press, Oxford (2007)
11. Kinnie, N., Hutchinson, S., Purcell, J., Rayton, B., Swart, J.: Satisfaction with HR practices and commitment to the organisation: why one size does not fit all. Hum. Res. Mgmt. J. **15**, 9–29 (2005)
12. Boxall, P., Macky, K.: High-performance work systems and organisational performance: Bridging theory and practice. APJHR **45**, 261–270 (2007)
13. Lis, K.: The levels of safety culture. In: Arezes, P., Carvalho, P. (eds.) Advances in Safety Management and Human Factors, pp. 193–201, AHFE Conference, Kraków (2014)
14. Horbury, C., Wright, M.: Development of a multiskilling life cycle model. HSE Books, Norwich (2001)
15. DeVaro, J., Farnham, M.: Two perspectives on multiskilling and product-market volatility. Lab. Econ. **18**, 862–871 (2011)
16. Chase, B., Karwowski, W.: System integration in advanced manufacturing technology. In: Holman, D., Clegg, C.W., Wall, T.D., Sparrow, P., Howard, A. (eds.) The Essentials of the New Workplace - A Guide to the Human Impact of Modern Working Practices, pp. 55–70. John Wiley & Sons Ltd, Chichester (2005)
17. Phillips, J.J., Connell, A.O.: Managing Employee Retention. A Strategic Accountability Approach. Elsevier, Butterworth- Heinemann (2003)

18. Bartkowiak, G.: Człowiek w pracy: od stresu do sukcesu w organizacji. PWE, Warszawa (2009)
19. Turek, D.: Kontrproduktywne zachowania pracowników w organizacji: przejawy, uwarunkowania, ograniczanie. Difin, Warszawa (2012)
20. Frey, C.B., Osborne, M.A.: The Future of Employment: How Susceptible are Jobs to Computerisation? OMS Working Papers, Oxford (2013)
21. Bakshi, H., Frey, C.B., Osborne, M.: Creativity vs. Robots. The Creative Economy and The Future of Employment. Nesta, London (2015)
22. Olszewski, J.: System pracy w warunkach rozwiniętego społeczeństwa informacyjnego. Uniwersytet Ekonomiczny w Poznaniu, Poznań (2013)
23. Wright, P.M., McMahan, G.C.: Exploring human capital: putting human back into strategic human resource management. Hum. Res. Mgmt. J. **21**, 93–104 (2011)

Leading Learning Schools

Tibor Baráth

Abstract The paper introduces a newly developed model for schools as learning organization. The elaboration of the model was based on a longitudinal research and development project; the large scale research involved 82 schools, their leadership and teaching staff. The research report gives a clear description about the synchronous and diachronic model of learning organization and the validation of that. It also presents the leadership tasks and roles in it, and provides deep insight into the characteristics of the school leadership of schools aspire to become learning organization.

Keywords Learning organization · School leadership · Synchronous and diachronic model · Leaders roles and characteristics · Behavior competence · Attribute

1 School Leadership and Student Achievement

Learning, learning quality and efficiency are undoubtedly among the most important issues of knowledge society. Therefore the school, which plays a key role in unfolding and developing student competencies as well as transferring the knowledge required for individual success and the society's evolution, is a decisive factor in shaping the quality of learning.

Much has been said about the importance of leadership in the management, the success and the efficiency of profit-oriented organizations, so now it is worth examining what impact school leadership can have on the quality of the school's core activities (i.e. learning and teaching), and through this, the students' academic and non-academic achievements.

If we look at the relationship between school leadership and students' learning results, we will notice that strong faith and conviction are involved. At the same

T. Baráth (✉)
Hungarian-Netherlands School of Educational Management, University of Szeged,
Dugonics Tér 13, Szeged 6720, Hungary
e-mail: barath@kovi.u-szeged.hu

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time, we should examine the question as to what facts can prove the impact and the scale of leadership.

Several research programs were aimed at finding the relation between the characteristics of school leadership (formal parameters, leadership style, activities, etc.) and learners' efficiency. Some of the findings suggest that there is no or very little impact that leadership has on learners' efficiency [1–3].

One of the most significant results were revealed by Hallinger and Heck [4], who conducted the secondary analysis of research projects carried out between 1980 and 1995. They concluded that leadership has a fundamental indirect impact on learner achievements. The researchers identified the areas through which leadership exerts an indirect impact, and these are the following: common objectives and mission (intentions, plans); structure and community relations (network); people (teachers, parents, students, local leaders); organizational culture. They found that the impact was significant but relatively weak.

Leithwood, Luis et al. studied the scale of leadership impact as well as its mechanisms. They found that school leadership is a school factor with the second biggest impact that can influence learning. The (direct and indirect) impact of leadership explains one quarter of the school impacts regarding learner outcomes. This study underlines the importance of the following areas: mission, vision, objectives; developing teachers, personalized support; knowledge management; learning-focused organizational culture [5, 6].

Between 2006 and 2009, Day et al. conducted a longitudinal research project to examine the impact of school leadership on learner outcomes. They confirmed that school leadership is a factor with the second biggest impact after class teaching. The researchers found that leadership impacts are typically weak, therefore efficient leadership is characterized by a synergic alignment of these impacts [7].

Next we will describe two research projects, the findings of which have served as focal points in the development of our own model.

One of these prominent school organizational research projects took place in Australia. At the turn of the millennium, Mulford et al. [8, 9] launched a longitudinal, large scale research project (LOLSO, Leadership for Organizational Learning and Student Outcomes), the fundamental aim of which was to find a link between organizational learning, school leadership and learning outcomes; to provide an empirical base for the interpretation of the school as a learning organization; and to support fact-based school development reform.

On the basis of Senge's model applied for schools Mulford et al. identified seven characteristics of a learning organization: situation analysis, vision and objectives, initiatives and risks, review, acknowledgment and reinforcement, continuous professional development [9, 25–27]. After processing the data with factor analysis, one factor was underlined with four components (a climate based on trust and cooperation; initiatives and risks; a shared and monitored vision; professional development) [9, 28, 29].

The other study was conducted by Pol et al. between 2009 and 2011. The project named Leadership in the Processes of Organizational Learning in Schools (LPOLS) was aimed at finding an interpretation for the concept of organizational learning;

Table 1 Correlations between the factors of the theoretical and empirical models

	Values	Knowl. sharing	Responsibility	Innovation	Network	Leadership	Learn. teach.
Responsibility and trust	0.830	0.754	0.808	0.617	0.688	0.758	0.814
Partnership in learning	0.662	0.750	0.657	0.526	0.662	0.640	0.834
CPD	0.920	0.846	0.902	0.715	0.770	0.726	0.784
Learning and teaching	0.774	0.710	0.689	0.574	0.679	0.744	0.878
Differentiated learning	0.751	0.734	0.718	0.632	0.684	0.630	0.833
Leadership sup. learning	0.841	0.731	0.781	0.600	0.691	0.927	0.795

exploring its specialities at Czech schools; and—on the basis of these—developing an integrated model for learning school organizations [10–13].

Regarding organizational learning [10, on the basis of the Table 1, 155], Pol et al. concluded that it is: intentional, determined; encompasses the entire organization; defined by the school culture; operated by identifiable driving forces; creates and shares knowledge; it takes place simultaneously within the organization and is about the organization; it results in change in quality; it happens with the participation of every actor.

2 The Model for School as a Learning Organization and Its Leadership

Next we will describe the concept of the learning organization R&D model. Our fundamental aim was to create a construction that has a sound theoretical foundation as well as practical applicability.

In order to develop the model, we explored the theoretical background of learning organizations, and we studied the relevant research. Figure 1 shows what factors were prominent as input for the learning organization when creating the model [9, 10, 13–15], and what influenced the efficiency of the link between leadership and learning outcomes [6, 7]. For the purpose of articulating a precise definition, we made a distinction between the concepts of organizational learning, learning organization and professional learning community. Several of the research projects confirmed that the schools characterized by the attributes of a learning organization tended to react more promptly to challenges; their efficiency increased [9, 16–20]; trust, cooperation and workplace learning became key elements of the organizational culture [21] and network operation was considered essential [22, 23].

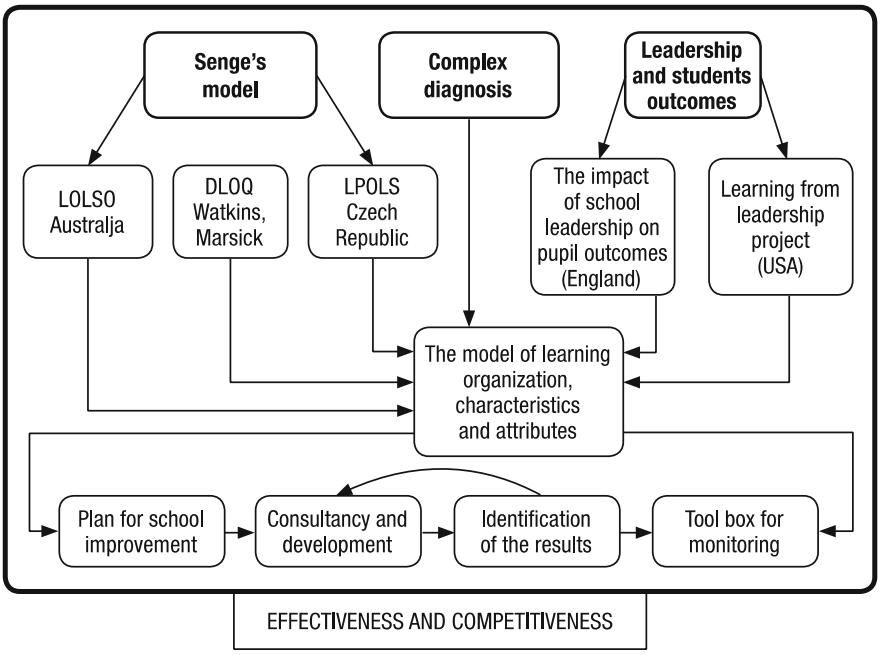


Fig. 1 Concept of developing learning organization model for schools

In addition to studying the professional literature, experience had a decisive role in developing the model. This meant a complex organizational diagnosis, which amalgamates the SWOT analysis prepared by schools as self-diagnosis, the organizational culture and efficiency analysis built on the Competing Values Framework [24] with the exploration and analysis of the behavior competences of the organization's key players [25]. The learning organization profile drawn during the diagnosis served as the empirical foundation for developing the model [26].

The concept involved supporting the realization of the institution development plan in the form of special training and flexible, situation-suited consultancy. 82 institutions participated in the project, which was realized according to the concept illustrated basically in Fig. 1.

2.1 The Synchronous and Diachronic Model of the Learning Organization

Our aim was to develop a construction that is suitable for taking a snapshot of the institutions at a given stage and at a given time, which meant that we focused on the characteristics and the attributes identifiable at the time of our observation—this is the synchronous approach. At the same time, the model should be suitable for

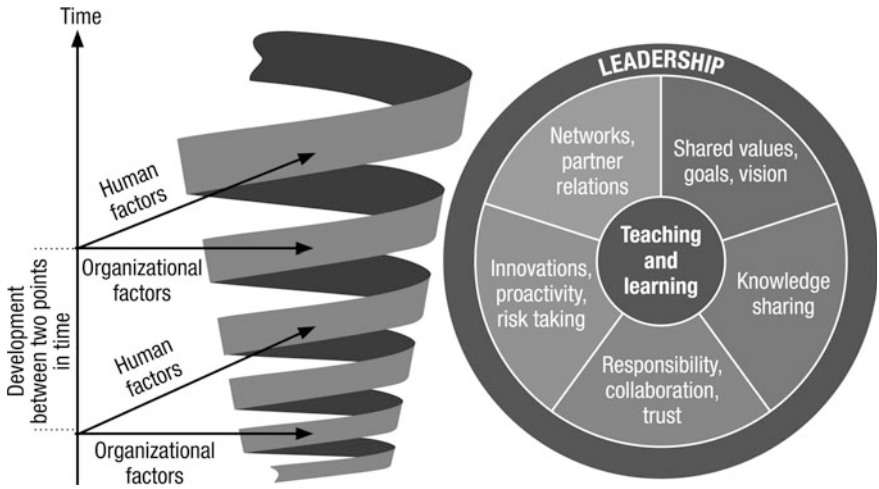


Fig. 2 The synchronous and diachronic model of the learning organization

identifying the school's development path. In other words, the model should be able to examine the learning organizational operation from a comprehensive perspective, which focuses on evolutionary changes—this is the diachronic model. While the synchronous approach supports the contentual definition of the organizational behavior attributes, the diachronic approach assists us in exploring the long-term operation and evolution of the learning organization. It describes how the operational and behavioral attributes change with time, and it depicts the processes that serve the purpose of improving the quality of learning and teaching. Figure 2 illustrates the joint model of the synchronous and the diachronic approaches.

2.2 The Content of the Synchronous Model

In the first phase of the development, what served as a basis for the synchronous model was a sentence list, which was compiled during a wide-scope, intensive expert discussion and which described the learning organization's operation and behavior [26]. The diagnosis and the organizational profile used in the diagnosis as a reference point were built on this sentence list. The experiences drawn from the diagnosis and the research findings relevant regarding our topic confirmed that the description of the organizational behavior as a method as well as the actual content of the sentence list are suitable to serve as a basis for defining the attributes of the learning organization. The sentence list was analyzed for relevance, interrelation, overlaps and entirety. As a result, we got a final description of the organizational attributes, which were grouped, yet again after several modifications. As shown in Fig. 2, we identified six areas that influence and determine the state and the quality

of the school's core business at the level of both the individual and the organization. The six areas are as follows: (1) shared values, vision, goals; (2) knowledge sharing; (3) responsibility, cooperation, trust; (4) innovation, initiative, risk taking; (5) network connections, partnerships; and (6) leadership, the characteristics and inter-relations of which fundamentally determine the quality and the changes of classroom processes, learning and teaching, the efficiency of pedagogical work, and through this, in most of the cases, the competitiveness of the schools.

In the center of the synchronous model stands learning with its supporting activity, i.e. teaching. The surrounding factors (activity systems) appear separately in our model, but in real life they determine the dynamics of the organizational operation through complex interactions. Leadership in the outer circle virtually encompasses and systemizes the factors, it harmonizes them and ensures the synergy of the impacts. Next, two selected areas will be described so that we can gain a deeper understanding of the synchronous model.

Learning and teaching

This area describes the goal and the meaning of the school's activity. It collects those behavior attributes on the basis of which we can judge whether the school can create the inspirationally, emotionally and physically optimal learning environment for the students; whether the school can efficiently operate the pedagogical processes and actively support students' learning. The characteristics of this area help us understand what learning and learner image teachers have and whether in the center of this image stands an interpretation that focuses on learner needs, the complexity of competence development, cognitive psychology and learning science results. In schools that operate as learning organizations, teachers are dedicated and feel responsible for the development of the students, they consider the group as the natural environment for learning and their learning organizational methods are adjusted to the modern interpretation of learning processes. In these institutions, the continuous monitoring and analyzing of learning results, frequent reflection on and discussion about teaching methods are all taken for granted. Here are three examples from the sentence list: The teachers are always motivated about the development of their students' cognitive, personal and social competences. Problem-centered teaching and learning as educational philosophy and method are present in the teaching and learning process. The efficiency of the teaching program is continuously monitored.

Leadership

Learning-centered leadership describes the typical leader activities in terms of harmonizing the areas with one another, the knowledge-intensive operation of the organization, responsibility, initiating innovative ideas, supporting, adopting and successfully implementing emerging novelties. Leadership builds on learning embedded in work and activities, and it consciously utilizes informal and non-formal learning possibilities. The leaders are aware that their main task and responsibility is to optimize learning possibilities, to achieve successful learning, the road to which is the systematic operation of indirect impacts. Here are three

examples from the sentence list: Leadership promotes reflective learning situation analysis as a learning method as well as case studies in groups. Shared leadership is in practice. Leadership provides support for the development and improvement of colleagues.

2.3 *Validation of the Learning Organization Model for Schools*

The synchronous-diachronic model was in harmony with the model used during the diagnosis, which proved relevant in the course of drafting the schools' development plans. At the same time, it was important to see what the selected schools' teachers and leaders thought of the model. We held a hypothesis according to which the institutions whose results suggest that learning plays a pivotal role in their operation can judge well what organizational characteristics are necessary for the learning organizational operation.

We used three questionnaires for validating the model: one for the school directors, one for the school's deputy heads and one for the teachers. The questionnaire statements were partly identical and partly different. The validation of the model was performed on the basis of how much the respondents found the organizational behavior attributes important; and if they found some important, what structure could these statements be arranged in. (The respondents evaluated the statements on a 4-level scale.) For the purpose of supporting the development, the respondents were encouraged to indicate to what extent they found the organizational behavior forms typical of their own institution.

Out of the 82 schools participating in the sample, 62 gave a valid answer (75 %). According to the filtered database, the questionnaire was filled in by 1192 (27 %) teachers, 119 deputy heads and 62 (75 %) principals. Using the "important" statements, we examined the validity of the theoretical (synchronous-diachronic) model with the help of the confirmative factor analysis. Thus we could conclude that the content categories of the theoretical model were—with minor corrections—correlatable with the areas of the empirical model.

We examined the correlation between the areas of the theoretical and the empirical models with the help of correlation analysis, and found (See Table 1) that the lowest correlation coefficient between the factors (areas) of the two models is 0.526, which can be considered a rather good value, while most of the correlation values are above 0.7, which is very high. We can conclude that the synchronous-diachronic model described the learning organizational characteristics in a reliable way, therefore only minor corrections were necessary when developing the final model (Fig. 3).

In the center of the corrected model stand learning and teaching, closely related to these is continuous professional development, which serves the purpose of improving the quality of learning. In the center of the model, which resembles the

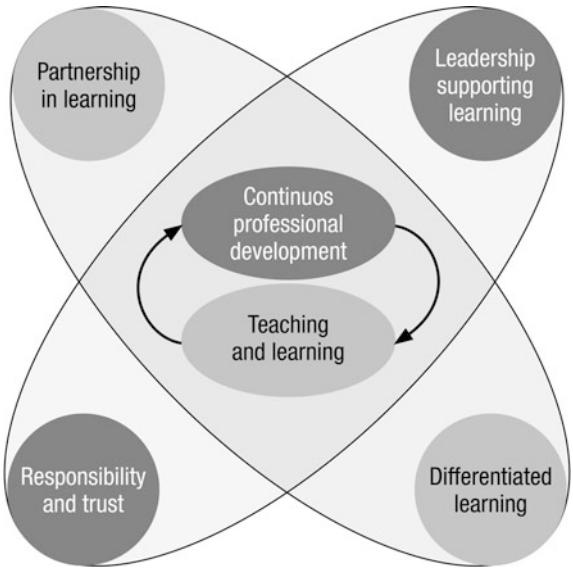


Fig. 3 The validated model of schools as learning organizations

atomic model, is the core, which is closely connected to responsibility and trust, leadership supporting learning is related to CPD, while partnership is linked to learning, and differentiation belongs more to the dimension of learning and teaching.

The detailed description of these findings goes beyond the limitations of this study, therefore here, we wish to highlight only one important conclusions. With the aggregation of the appropriate variables, we determined the competitiveness [27] and organizational learning [28] index. This way we grouped the respondents into three categories of approximately the same size (low, medium, and high competitiveness and organizational learning), and found that the mean average values scored along the learning organizational factors of these groups are clearly different, i.e. lower index goes with lower factor value. This proves that the model is suitable for grasping the various levels of the learning organizational operation.

3 The Characteristics of Leadership in Schools that Move Towards a Learning Organization

We used a complex method for examining leadership. We studied the behavior competence characteristics of those involved [25], and applied the leader roles of the Competing Values Framework and their relations with learning organizational features. With the help of the CVF, we can examine leadership orientation and dimensions (internal maintenance and external positioning; individuality, flexibility and stability, control). Behind the dimensions, we can distinguish four organizational

forms (their metaphors: adhocracy, market, hierarchy, clan). Finally, eight leading roles can be matched with each organizational form [29], (for its application to schools, see [30]). In this part of our analysis, we will check whether we can find any differences—if so, what type of differences—between the leadership characteristics of the sample institutions with high and medium level experienced schools in learning and institution development.

We used the CVF questionnaire of 36 statements for identifying leadership characteristics. The respondents evaluated the statements on a four-level scale according to how much they found it typical of themselves (leaders), and of their leaders (teachers). For the analysis on the organizational characteristics, see [31].

Table 2 illustrates that HIES schools are characterized by a higher degree of orientation along both dimensions than the other group of schools. This can mean that along this dimension, the leadership of the HIES group performs a more characteristic and profound activity. External orientation basically means conforming to the maintainer's (state) expectations in Hungarian schools, and control also means supervising that these expectations are satisfied. Less attention is paid to internal processes (Table 3).

According to the organizational forms, leadership shows similar differences between the two groups of schools, just like in the case of dimensions. The ranking order of each form shows a slight difference in the cases of adhocracy and hierarchy forms. Major differences can be found in leadership roles belonging to the organizational forms (leading type/leadership role). This is reflected in Table 4, where the role-related mean averages and their differences are illustrated.

On the basis of the statements for leadership roles, it became obvious how leaders see themselves in the roles of the CVF, while the teachers expressed how they see their leaders in these roles. Table 4 contains the average and the differences

Table 2 Leadership roles and orientations

	HIES (15)[1]	MIES (67)
External orientation	3.5045	3.24
Internal orientation	3.32	3.075
Flexibility	3.3695	3.0975
Control	3.455	3.2425

[1]HIMES (15): it means that 15 schools were selected and involved in the project which had high level experience in learning and institution development; MIES (67) means that there were 67 schools having medium level experience

Table 3 Rank order of the CVF models regarding the leadership roles

	HIES		MIES	
Human relations (Clan)	4.0	3.25	4.	2.965
Open system (Adhocracy)	2.0	3.49	2–3.0	3.18
Rational goal (Market)	1.0	3.52	1.	3.30
Internal process (Hierarchy)	3.0	3.39	2–3.0	3.185

Table 4 Leadership roles—differences in conception according to positions and groups

Leader role	Director MlES	Teacher MlES	DM-TM	Director HlES	Teacher HlES	DH-TH
Facilitator (F)	3.31	2.96	0.345	3.51	3.20	0.308
Mentor (M)	3.40	2.97	0.439	3.58	3.30	0.287
Innovator (I)	3.448	3.150	0.298	3.580	3.468	0.112
Broker (B)	3.32	3.21	0.105	3.69	3.51	0.180
Producer (P)	3.34	3.26	0.082	3.51	3.50	0.006
Director (D)	3.46	3.34	0.126	3.62	3.54	0.083
Coordinator (C)	3.13	3.13	−0.007	3.42	3.34	0.085
Monitor (Mo)	3.25	3.24	0.012	3.39	3.44	−0.052

of the leaders' and teachers' answers for both school groups. One of the conclusions we can draw is that both leaders and teachers gave higher values for fulfilling leadership roles in the case of HlES schools than in the case of the MlES group. The respondents' opinion indicates that the leadership of the school group that is more advanced in the learning organizational operation performs better in the various roles. When comparing the leaders' and teachers' answers in the MlES and HlES groups, we can notice that leaders gave higher points for their self-recognition in the various roles than teachers. The leaders think that they perform better in the various roles compared to what the teachers' responses confirmed. Finally, we can conclude that in the MlES group, the leaders found the fulfillment of the roles of the director and innovator most characteristic, whilst teachers ranked the fulfillment of the director and monitor roles first. An even larger difference can be observed if we examine the roles with the lowest scores. Leaders ranked the coordinator and the monitor roles here, while teachers ranked the facilitator and mentor roles here. These latter are interesting because there is quite a large difference between the averages. In the case of the HlES schools, the roles receiving the highest scores are almost the same for both the leaders' self-recognition and the teachers' opinion. As for the roles with the lowest points, however, we can see the same result as we did in the case of the MlES group, i.e. here again, the leaders considered themselves weaker/better performing in the same roles as in the MlES group, and the same applies for the teachers. In the case of the leader roles with low scores the difference between the two groups is that in the HlES group, the difference between the leader/teacher averages is slightly smaller.

We can get a deeper insight into leadership roles if we look at the difference between the teacher responses of the two groups. Table 5 shows the statements where the biggest differences can be observed among the teachers' recognition. (After each statement, you can see the leader role indicated by its initial.)

We can draw the following conclusions after analyzing the table. The HlES school's teachers always ranked their leaders' role performance higher than did the teachers of the MlES schools. Out of 13 statements, 6 are related to the Open

Table 5 Differences between teachers' recognition regarding leading roles (HlES and MlES)

Statement: As a leader I	Teacher (MlES)	Teacher (HlES)	MlES-HlES
1 Come up with inventive ideas.**I**	3.0473	3.4007	−0.353
2 Exert upward influence in the organization.**B**	3.0196	3.3466	−0.327
3 Clarify the need to achieve unit goals.**P**	3.1702	3.4993	−0.329
4 Search for innovations and potential improvements.**I**	3.2964	3.6265	−0.330
5 Listen to the personal problems of employees.**M**	2.9563	3.2650	−0.309
6 Treat each individual in a sensitive, caring way.**M**	2.8783	3.1989	−0.321
7 Experiment with new concepts and procedures.**I**	3.0730	3.3636	−0.291
8 Show empathy and concern in dealing with employees.**M**	3.0028	3.3410	−0.338
9 Seek to improve the workgroup's technical capacity.**P**	3.0983	3.4118	−0.313
10 Encourage participative decision making in the group.**F**	3.0652	3.3512	−0.286
11 Do problem solving in creative, clear ways.**I**	3.1830	3.4792	−0.296
12 Show concern for the needs of employees.**M**	3.0245	3.3785	−0.354
13 Influence decisions made at higher levels.**B**	3.0682	3.4449	−0.377

System model, and 5 to the Human Relation model. This shows which are the areas where the teachers of those schools that perform better in the learning organizational operation clearly evaluated higher the role fulfillment of their leaders. These areas are as follows: impact made on organizational processes and creativity, as well as sensitivity and attention towards colleagues (their personal situation, their intentions, their endeavors, the utilization of their knowledge, etc.). This also means that according to the teachers, the leaders of the HlES schools were far better than the MlES leaders in those roles that the teachers found least fulfilled, compared to the rest of the roles. This, together with the characteristics of the learning organizational shows that leadership operation and developing the activities in the fields (Open System model and leadership roles belong to it) that increase the dynamism of the organization as well as in the fields of the Human Relation Model are required for a school to become a learning organization, which enables leaders to rely more on the knowledge and experience that is present in the organization, and to develop the learning environment.

When comparing the leaders' self-recognition results in the two school groups, we will get results that are in many respects similar to those of the teachers. Without going into details, we can conclude that just like in the case of the leaders' self-evaluation, the principles of the HlES schools evaluated their own activities higher for all CVF roles than did the MlES school leaders. Although the differences were smaller for the leader roles than in the case of the teachers (range: 0.179–0.375), the difference for each statement was bigger (range: 0.000–0.542), also due

to the smaller item number. As for the various areas, the biggest difference was observed in the roles of the broker and the coordinator.

In essence, we can say that the self-recognition of the HlES and the MlES schools show a similar pattern regarding the fulfillment of the CVF leader roles to the those of the teachers. The self-evaluation (self-recognition) data for the fulfillment of leader roles also confirm that openness, creativity, attention paid to people, inclusion, goal-orientedness are the attributes that are mainly needed for a school to become a learning organization.

4 Conclusions

Above we described a new learning organizational model that was targeted for schools. We could conclude that a description (sentence list) containing the organizational behavior characteristics prepared for the learning organizational diagnosis provided an appropriate starting point for the theoretical model, i.e. the synchronous-diachronic model, which was validated by a questionnaire examination. The final and extensive school data collection-based model only required minor adjustments, therefore we can conclude that we managed to develop a model with the help of which the school's learning organizational characteristics, and through this, the school's competitiveness can be grasped together with the changes of these with time.

With the help of an empirical examination, we explored some of the important characteristics of school leadership, and we found proof for the fact that at the various levels of the learning organization's operation, leadership is also characterized by various conceptions and performances of the roles.

References

1. Leitner, D.: Do principals affect student outcomes? An organizational perspective. School Effect. School Improv. **5**, 219–238 (1994)
2. Bosker, R.J., Witziers, B.: The magnitude of school effects. or: does it really matter which school a student attends? Paper presented at the Annual Meeting of the American Educational Research Association, New York, April (1996)
3. Scheerens, J., Creemers, B.P.M.: School effectiveness in the Netherlands: the modest influence of a research programme. School Effect. School Improv. **7**, 181–195 (1996)
4. Hallinger, P., Heck, R.: Exploring the principal's contribution to school effectiveness: 1980–1995. School Effect. School Improv. **9**(2), 157–191 (1998)
5. Leithwood, K., Seashore Louis, K., Anderson S., Wahlstrom, K.: How Leadership Influences Student Learning. Executive Summary. The Wallace Foundation (2004)
6. Louis, K.S., Leithwood, K., L. Wahlstrom, K.L., Anderson, S.E.: Investigating the Links to Improved Student Learning. Final Report of Research Findings. University of Minnesota, US (2010)

7. Day, C., Pam Sammons, P., Hopkins, D., Harris, A., Leithwood, K., Gu, Q., Brown, E., Ahtaridou, E., Kington, A.: The Impact of School Leadership on Pupil Outcomes. Final Report, University of Nottingham, England (2009)
8. Mulford, B., Silins, H.: Leadership for organisational learning and improved student outcomes—what do we know? Cambridge J. Educ. **33**(2), 175–195 (2003)
9. Silins, H., Zarins, S., Mulford, B.: What characteristics and processes define a school as a learning organisation? Is this a useful concept to apply to schools? Int. Educ. J. **3**(1), 24–32 (2002)
10. Pol, M., Hlousková, L., Lazarová, B., Novotny, Pés Sedlácek, M.: On definition characteristics of organizational learning in schools. In: Baráth, T., Szabó, M. (eds.) Does Leadership Matter? Implications for Leadership Development and the School as a Learning Organization. SZTE KÖVI és Nemzeti Tankönyvkiadó, Budapest-Szeged, pp. 147–157 (2010)
11. Palán, Z.: Výkladový slovník vzdělávání dospělých. Daha, Praha (1997)
12. Bedrnová, E., Nový, I., et al.: Psychologie a sociologie řízení. In: Management Press, Praha (2002)
13. Pol, M., Hloušková, L., Lazarová, B., Novotný, P., Sedláček, M.: Organizational learning in Czech schools explored. Akdeniz University, Faculty of Education, Anakara, pp. 187–197 (2012)
14. Senge, P.: The Fifth Discipline. The Art & Practice of the Learning Organization. Doubleday, New York (1990)
15. Watkins, K.E. és Marsick, V.J. (eds): In Action. Creating the Learning Organization. American Society for Training and Development, Alexandria (1996)
16. Corcoran, G., Goertz, H.: Instructional capacity and high performance schools. Educ. Res. **17**(9), 27–31 (1995)
17. Issacson, N., Bamburg, J.: Can: schools become learning organizations? Educ. Leader. **50**(3), 42–44 (1992)
18. Louis, K.S.: Changing the culture of schools. professional community, organizational learning and trust. J. School Leader. **16**(5), 477–489 (2006)
19. Strain, M.: Schools in a learning society. new purposes and modalities of learning in late modern society. Educ. Manage. Admin. **28**(3), 281–298 (2000)
20. Schechter, C. Organizational learning mechanisms. the meaning, measure, and implications for school improvement. Educ. Admin. Quart. **44**(2), 155–186 (2008)
21. Horváth, L.: Informális tanulás a munkahelyen: a tudásmegosztás kompetenciájának fejlesztése. Kultúra és Közösség **5**(3), 115–132 (2015)
22. Hidding, G.J., Catterall, S.M.: Anatomy of a learning organization. Turning knowledge into capital at andersen consulting. Knowle. Process Manage. **5**(1), 3–13 (1998)
23. Huber, G.P: Organizational learning. The contributing processes and the literatures. Org. Sci. **2**, 88–125 (1991)
24. Cameron, K.S., Quinn, R.E.: Diagnosing and Changing Organizational Culture. Jossey-Bass, San Francisco (2011)
25. Baráth, T.: The Role Diagrammatic Approach. In: Kirkham, G., Révai, N. (eds.) The art and science of leading school—Central5: Central-European view on competencies for school leaders. Tempus Public Foundation, pp. 219–225 (2013)
26. Baráth, T. (ed.): Dél-Alföld megújuló iskolái. Szegedi Egyetemi Kiadó, Juhász Gyula Felsőoktatási Kiadó, Szeged (2015)
27. Horváth, L.: A tanulástámogató iskolai szervezet hatása a tanulói eredményességre. TDK dolgozat (2013)
28. Horváth, L.: Tudásmenedzsment a tanulószervezetben. Közoktatási Vezetőképző és Továbbképző Intézet, Szeged, Kézirat (2014)
29. Quinn, R.E., Faerman, S.R., Thompson, M.P., McGrath, M.R.: Becoming a Master Manager. John Wiley & Sons, Inc., New York (1996)

30. Baráth, T.: Hatékony iskola. In: Baráth, T., Golnhofer, E. (eds.) Iskolavezetés és fejlesztés I, pp. B1–B85. Szeged, JATE (1997)
31. Baráth, T.: Learning organization as a tool for better and more effective schools. In: Procedia Manufacturing, vol. 3. Elsevier, USA, 1494–1502 (2015)

The Atypical Approach to the Development Process of Tertiary Education

Attila Mészáros Attila and Enikő Baróti

Abstract The environment of the 21st century adult and tertiary education has changed at several places. The obstacles of information flow have disappeared and the educational environment has been virtualized. At the same time, the learning habits of students have also changed radically. These changes should be followed by tertiary and adult education as well. By accepting these phenomena workers of tertiary and adult education have to face a lot of fresh challenges. It is very important for them to adjust to the trends mentioned above Even those people who are not certified teachers need information, pedagogical and psychological knowledge to be able to find their way in the pedagogy of adult and tertiary education.

Keywords Tertiary education · The thinking barrier · The feeling barrier · The feeling Barrier)

1 Introduction

We need teachers who are able to accompany their students on their professional and fate learning way at the same time, thus new educational strategies are needed. The training of excellent teachers and trainers is one of the most urgent tasks of the future. Mass education has provided an opportunity for a lot of people to learn, and it can be regarded as success. On the other hand, it is very difficult to keep pace with the motivation and the differentiated knowledge of the entering students, and building relationships with them. There are not any pedagogical-methodological or

A.M. Attila (✉)
Teacher Training Centre, Széchenyi István University, Egyetem tér 1, Gyor 9026, Hungary
e-mail: meszaros@sze.hu

E. Baróti (✉)
Department of Structural and Geotechnical Engineering, Széchenyi István University, Egyetem tér 1, Gyor 9026, Hungary
e-mail: ebaroti@sze.hu

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teacher-human answers to it and it cannot lead to real quality changes on the long term as the problems are only partly resolved.

Teaching in adult and tertiary education is a particular profession. It means much more than knowing a special field of science and conveying it. At the moment, the only quality indicators are the professional and scientific requirement expectations. Thus the field mentioned above should be improved by our own motivation due to the lack of expectations. We all meet the anxiety experienced because of the necessity, the invariability of ended things [1]. To resolve this problem 'people training' should be integrated in the professional training of future universities. Education must not lose its humanistic aspects [2]. Furthermore, we need to make efforts to find the right profession-specific learning situations and methods on this teaching-studying way.

How can the attention receiving the intellectual impulse of the future generation be realized? How can we find the educational way to follow to be able to help our students to become professional and useful citizens? This study gives ideas to rely on when answering the above questions.

2 The Adult and Tertiary Eduction as a Scene of 'People Training'

The training should be life- and professional practice-oriented. The aim of the teachers is not to convey their own point of view to their students, but to help them develop their own ability to judge things. A Dean of a College of Technology stated that he often had to give a degree to engineers who completed their exams although he was convinced that they were not 'real' engineers. Being asked what he means by 'real engineers' he mentioned what social and cultural responsibilities those people should have who manage scientific research and production, but they were not prepared at all for taking such responsibilities. A lot of people become managers, but they have never learned to manage their fellows in an up-to-date way. So the 'people training' is also missing here' [3].

We mention only some of the phenomena:

- people are 'switched off' in education, so they just get passive knowledge
- the one-sided professional specialization is very narrowing, it has a lot of unfavourable social and personal side effects
- a kind of one-sided scientific authority predominates, the individual judgement becomes weaker
- The training has a conditional effect, a good example of it is the professional deformity which can be experienced later, and it can lead to being unsuccessful at the labour market

The adult and tertiary education have to meet two important requirements:

- Firstly, the profession and qualification have to be in focus in the adult and tertiary education. Every field of science needs different educational methods which have to be found by the determined teachers and representatives of the profession based on the impulses of the students. So we need to have a differentiated tertiary education pedagogy relying on the certain professional fields.
- Secondly, if a trained professional enters the labour market, he or she will take up a position in the society. Thus tertiary and adult education have not only to give the students professional qualification but high-quality human qualification as well because they have to be the bearer and transformer of present-day culture.

We can state that adult and tertiary education need to find new ways that each professional field has to find for itself. They have to select the most suitable training methods relevant to the given professional field. The latest experiment in the technological field is the dual engineer training.

3 The Human Integrating Basic Principles of the Adult and Tertiary Education

We would like to describe principles that are essential at all kinds of trainings. There can be crises in all people's lives, and also moments when they do not know how to go on. People can get indecisive, their emotions can fluctuate, and they get puzzled. This is the moment of human development when people become internally active, they start searching for the purposes and aims of inner and outer happenings. From this point of view, the recent period is the 'trainer' of adults. Our safety and trust has disappeared, everything that used to be evident and valuable has collapsed. There are doubts and fears in people. We can only find safety in ourselves, if we make enough effort. According to Jung we cannot judge to what extent we talk about perception and recognition if we just talk about psychical thinking and we deny the non-psychical, supersensible condition [4].

The spirit of the age requires us to awaken our own will, therefore the adult and tertiary education need to define the achievement of the will-awakening of all the people as its goal. It can be regarded as the first basic principle.

The independent studying will is in connection with the nature of the human personality, which is in relation to the human will. The human will is most importantly vitality, which is connected to the human body and it accompanies all the physical activities. However, there is a so-called original 'intellectual heat', apart from the biological will, which comes to existence if the person becomes enthusiastic about something he or she regards as valuable or nice. If this enthusiasm is followed by an activity, the individual and the will are linked up. Acting in things which inspire us is the awakening of the will itself. Most of the studying process is created by this 'heat process'. The three basic (usually unconscious) driving forces in studying represent the biologically bounded will being present in all the people: the tendency to recognize, develop and improve.

- The desire to recognize helps people adapt to the basics of the outside world, it maintains a constant process which tries to find out the human mystery. Its goal is to find the bridge that is necessary to be able to understand the world and ourselves.
- The desire of the human soul to improve is essential in the learning process. Through our walk of life in certain life cycles it is transformed again and again, it changes and we learn in different ways in our early or later cycles of life.
- The most unconscious willpower is the tendency to improve and also the feeling that we could have done everything in a better way. At the same time we realize that we have not achieved the state of perfection yet.

As a trainer we can have an essential question how to awaken these internal motivations in our students, because it requires a suitable methodology. A methodology which helps the students to become independent, supports the creation of his/her inner autonomy, the will to learn and judge independently, which is nourished by the three basic principles mentioned above. The training institutions need to be examined from the point of view that their courses improve the will and the personal judgement. It should be regarded as one of the main principles of high-quality education.

The second basic principle is based on the three resistance and working on them in the learning process. We acknowledge all the three barriers as equal. These resistances can be seen as three obstacles in our thinking-feeling and will world. We realize it as an obstacle which cannot be overcome and it generates fears and revulsions in ourselves. We reckon that we will not be able to cope with our tasks. So we need courage to be able to analyze these feelings and integrate them into our conscience not only by using the analytical intellectualization but the imaginative way of thinking which helps us to understand things more deeply.

Our system of feelings move in two directions: towards our thoughts and will. That is why it is important to learn how to examine our feelings with our thoughts and to strengthen our positive feelings with the help of our will. The tertiary and adult education have to recognize that the learning process is based on the work on these three contrariness and to find the right balance between them. The real change comes with the learning of essential things.

All the trainings that do not encourage the work on the ‘human central’ and emphasize one of the three obstacles may displace the human from his/her balance causing a lot of dangers. ‘The intellectual overemphasis without the connection of the balancing practical activities, the drilling of different skills without the real recognition. So the intellectualization and the drilling without the evaluating and connecting element of the feelings can lead to deformation, concretion and one-sidedness, moreover, to the damage of the whole learning process’ [5].

Thus it is a most important principle in the education and the learning process based on the three resistances: the barrier of thinking, feeling and willpower and working on them. This balance is very difficult to be made because people tend to overemphasize one of the above mentioned barriers. On the other hand, in the tertiary education and adult education a lot of effort is made to achieve this ‘barrier balance’, and the learning process based on the resistances, will yield and create the strongest power of mind and also build up moral power in the human soul. Let us

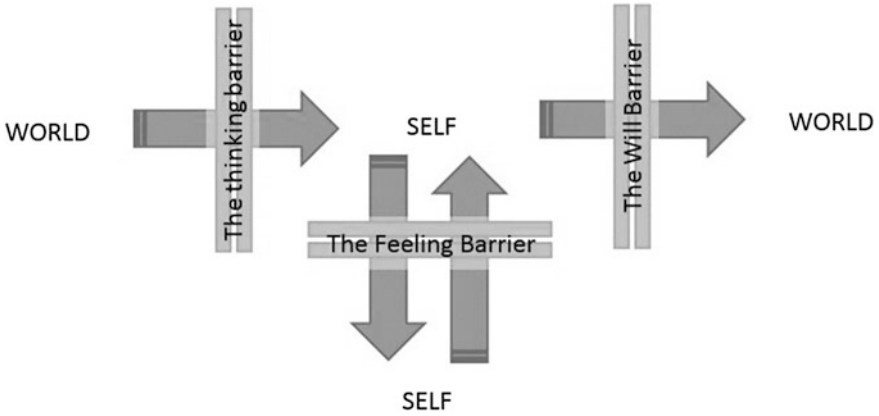
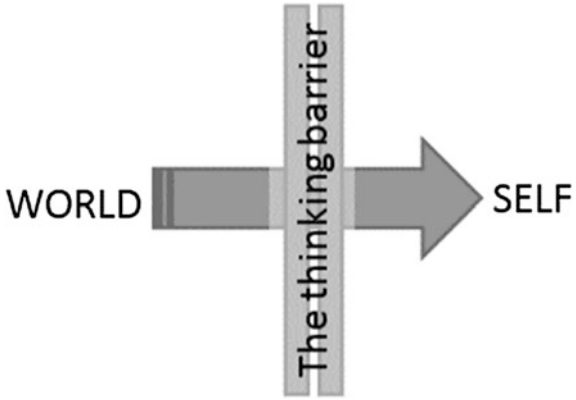


Fig. 1 The barriers appearing and to be overcome in the learning process (*source* Coenraad van Houten)

have a look at these three resistances as the obstacles to be present and overcome in the learning process (Fig. 1).

3.1 The Thinking Barrier



The ancient Greek philosophers started to examine the epiphany of human existence systematically. They found out that the thinking process has its rules and barriers as well [6]. Thus the people determined to recognize things meet new mysteries that help them to recognize the barriers of thinking. We have to recognize that the thorough observation of concrete things or the grabbing of abstract intuitive reality is more important for us. This is a threshold between the world and the human self. Our models of thinking only help to get to know a certain part of the world, the other reality is hidden and to be recognized.

The tasks of working on the thinking barrier can be the following:

- questioning and researching behaviour instead of passive knowledge acquisition
- we have to take care of the objective observation skill through our twelve sense organs as well as the skills of thinking because these two together can lead us to the truth
- we have to discover the difference between convergent and divergent way of thinking in our thinking skills and we have to be able to use them side by side. We have to develop our convergent way of thinking by a lot of effort and concentration, carrying out a thinking process step by step according to cause and effect and logical range coming to an exact consequence. To develop divergent way of thinking we only need to realize if we have an intuitive perceptivity and we need to open ourselves to this quick perceptive and spontaneous, creative way of thinking and recognition.
- we need to learn to differentiate between the things we know and the things we understand. The real understanding and learning is only possible if we work on all the three barriers.
- we have to recognize the one-sidedness in our thinking and if we have analytical, synthetic, imaginal or descriptive way of thinking.

Each person has a different way of thinking, so the teacher can never meet everybody's requirements. He/she needs to act as an advisor to be able to diagnose and overcome the obstacles. The student learns to face the outside world and understand its principles so that he/she can avoid making a mistake by adopting things without deeper understanding. A basic moral force being created during this process is the feeling of devotion, respect to the things of the world and to other people. At the same time it enables people to be devoted and recognize the values.

3.2 The Feeling Barrier



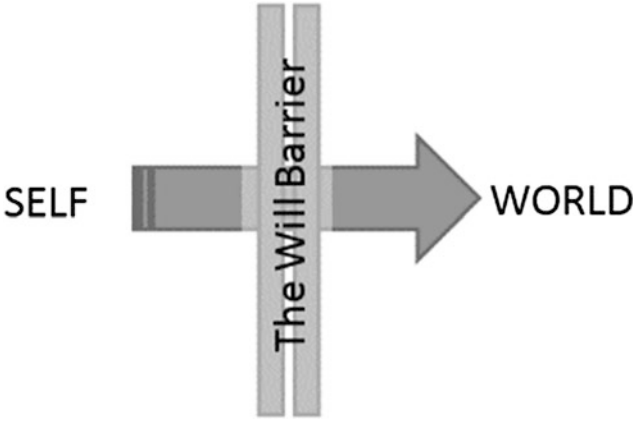
Here we meet a resistance that is shown in our feelings. This is not the relationship between the individual and the outside world but the one between the individual and her/himself and it is associated with the teacher and the participating students. Working on the feeling barrier gives people self-understanding, liberation and the inner maturity of the personality. They can experience that their feelings are very important elements of the learning and cognitive process. However, working on this barrier seems to be the most difficult and the least accepted among the trainers and the people participating in the learning process.

We can see a lot of resistance in the case of the trainers and they object to the fact that working on the inside feeling barrier is part of the learning process. Here the trainer stands in front of his/her own threshold. He/she has to decide if he/she is involved and lives through his/her own feelings and integrate it into the learning process encouraging his/her own students to do the same or stay in his/her authoritative, deformed, conditioning position without any empathy. However, with the exclusion of the personal feelings the learning process cannot contribute to the personal development. Working on the feeling barrier cannot only lead us to the recognition of ourselves but to the transcendent as well. The word 'knowing' is anomalous in this context because it suggests that the world can be recognized without feelings [7]. Therefore it is necessary for the trainer to have a friendly, emphatic attitude and recognize the values without criticism to be able to overcome this obstacle.

Only the working on this barrier can lead the learning process to self-recognition. The trainer can support the learners with helping interviews on this way. However, we confess that he/she should have bravery, resolution and self-recognition to be able to work on this barrier in the learning process and he/she is not trained for it for the time being. In many cases the students refuse the learning process because of the lack of working on this central field.

Working on this barrier can build up the moral force based on the loving ability empathy with the other self.

3.3 The Will Barrier



The basic feature of the willing resistance is the anxiety which exists inside us in a hidden way. The will barrier means a sort of action limit. This is the relationship of the self and the world. The inside desire to create and make things better is a willing impulse which make us take action. We would like to impress the outside world and make it change by assessing the possible outcome or instinctively, driven by an inside unconscious impulsion. A lot of people learn from their actions, 'get to know something by grabbing the world in an active way'. They are the extrovert type of people. Those who are keen on experimenting and lead their way to discovery. In the era of today's modern information technology these actions are given in advance, do not occur with the conscious leading of the self and do not occur by grabbing the personal individual will.

There are people who refrain from immediate actions, are introvert and tend to think things over before acting. In many cases there is a will paralysis that hinders actions and prevents us from approaching the thinking, feeling and will barriers actively. In training institutions we often experience that the learning will of our students is too weak, they tend to give up too soon if the have to face any difficulties, they do not have enough stamina etc. There is anxiety in the background which can be regarded as a barrier. In a learning process the most important problem manifests itself in the willing region. The fear of life, changes and future hinders the activity and it can lead to a sort of paralysation or mechanical actions which do not involve the cognitive and developmental objectives necessary for the personal and professional improvement, and lead to the correct adaptation of the learning process. Therefore the most important task of the trainer is to awaken the individual learning will by experiencing the effort of working on the three barriers in him/herself. Thus the training and teaching profession requires a continuous inside observation and the maintenance of flexibility, spontaneity, self-recognition, and the ability to learn and develop. It needs a kind of participation, the involvement of the individual personality. Meeting its requirements and the participation is a profession where similar abilities and maturity are needed. The understanding and the use of the Myer-Briggs theory can help to increase the standard of the teaching profession and the cognitive-information theory interpretation as well [8].

Some inspiring methods to awaken the own personal will of our students:

- the formation of a concrete creation containing artistic and new elements as well. It addresses the creative part of people and helps the connection with the substance, the physical reality. It also starts a spontaneous, creative process, which can be regarded as a pattern for a further learning process needing a deeper participation.
- a designing task, project work, which has an opened outcome
- teamwork, where cooperation is necessary which requires strong commitment and in this way it stimulates the will mainly in the case of groups
- developing evaluation and feedback methods

The work on this barrier builds up the third shell of moral force, the force of wisdom in the self which improves the ability to take responsibilities.

It is obvious that this learning process can address the whole personality and provide help and support in the process of preparing him/her for the future.

The third basic principle is based on the correct interpretation of the trainer-educator and student-participant relationship. We cannot ignore the relationship in the past and the custom of today which is inherited by the oncoming generation. In the past, the teachers and the professors were regarded as wise people, they were the masters of the given scientific fields, specified the learning way for their students who respected, awed them and were dedicated to the curriculum as well. These two basic moods are still present at the training institutions, especially the traditional universities having long histories. So coping with these tasks needs changes and effort from the side of the teachers and the students. It is about the meeting of two people: the university teacher and the university student according to the tertiary education denomination. In adult education it has a less hierarchical denomination proportional to the activity in the teaching-learning process.

This relationship takes place at three levels. At the first level the trainer the student i proceeded by the teacher from the point of view of curriculum and professional knowledge, otherwise he/she could not be a trainer. He/she makes his/her knowledge available for the students. The trainer stands above the student regarding his/her knowledge, he/she is superior. The second level is about human relationships where the two people need to be equal. At this level the inevitable meeting of two people and the emitting take place. The only choice to make the relationship work is the coequality, both people appear with their strengths and weaknesses in the relationship. The subordination and superordination level off here. At the third level the participant is in the focus, the trainer supports and serves his/her learning process. In the case of an optimal learning process their task is to change these three behavioural types and to find a balance and the appropriate attitude at the given levels. This basic principle also contributes to the creation of the suitable learning process.

Apart from the three levels the teachers need to make a creative knowledge transferring environment, too. This is important from three aspects, on the one hand we have to access the field we want to work in. On the other hand, the interactions are very frequent in a creative environment, so we need to realize a bigger emotional and thinking effervescence in the education. Thirdly, the educational institutions realizing new ideas stimulate the general condition of the teachers and the students as well. On the contrary, a barren area is left by the people who long for a better one [9].

4 Summary and Future Orientation

We have searched for answers, how we can think differently in tertiary and adult education, how we can put the focus from the knowledge transfer to the people whom we want to train to be a professional. When we talk about changes, it is about processes, where there are some new things shown, things that we have not seen before

[10]. How can we move away from the usual thinking and methodological ways which have become void and how can we make them up-to-date and renew our own teaching habits? How are the teachers motivated? What would be the right direction to the cultural changes of the tertiary and adult educational structure in the future?

Our students long for the fire found and looked after in our soul. They are not curious about the content, because they learn quickly if they find a goal. This is an inner process, that we can only achieve by struggling, it is like a birth, realizing our own personality and goals. This is the field where they need the biggest help. Without our understanding human support they are like a sleeping lost generation. So we must not forget that they rely on us. 'We tread on their dreams' [11].

Only by doing it can come a real quality into existence in education. At a prosperous university it is very important to create teacher workshops where people can talk about and process the questions of education [12]. Where those people who want to improve and are sceptical to themselves can receive answers to their questions. Where in a teaching community there is a real quality measure of the responsible thinking and deeds for the future generation.

References

1. Riemann, F.: Grundformen der Angst Ernst Reinhardt, Basel/München, 78 p. ISBN 3-497-00749-8 (1961)
2. Riemann, F.: Basic forms helfender partnership, 98 p. Selected Essays (ed. and with an introd. of Karl Herbert Mandel), Munich: J. Pfeiffer 1974, currently: Stuttgart, Klett-Cotta, 9th edition 2004, ISBN 978-3-608-89622-0 (1974)
3. Houten, V.C.: Erwachsenenbildung als Willenserweckung Freies Geistesleben, p. 5. ISBN 978-3772511615 (1999)
4. Jung, C.G.: Erinnerungen, Träume, Gedanken, 442 p. Walter Verleg AG, Olten ISBN 9783530407341 (1971)
5. Houten, V.C.: Erwachsenenbildung als Willenserweckung Freies Geistesleben, 10 p. ISBN 978-3772511615 (1999)
6. Csíkszentmihályi, M.: The Evolving Self, p. 60. A Psychology for the Third Harpers Collins Publishers, Inc, New York. ISBN 0-06-016677-0 (1993)
7. Kahneman, D.: Thinking, Fast and Slow, p. 201. Penguin Books Ltd, London. ISBN 978-0-141-03357-0 (2011)
8. MBTI types Books LLC, Reference Series ISBN: 115571119X (2012)
9. Csíkszentmihályi, M.: Creativity. Flow and the Psychology of Discovery and Invention Harper Perennial, pp. 136–143. Reprint edition (August 6, 2013). ISBN 978-0062283252 (1998)
10. Kast, V.: Sich wandeln und sich neu entdecken, p. 13. Verlag Herder GmbH, Freiburg. 978-3-451-04477-9 (1996)
11. Robinson, K.: Out of Our Minds: Learning to Be Creative. Capstone ISBN 190-731-247-1 (2001)
12. György, M.: New learning spaces? M-learning's, in particular the IPad's potentials in education. Int. J. Interact. Mobile Technol. **7**(1), 56–60 (2013)

Parameters for Assessing a Building Project Within the Purview of Constructability

Apurv Shrivastava, Devarshi Chaurasia and Shweta Saxena

Abstract With the advent new technology in the construction industry a lot of multistorey building projects are coming in India. The housing demand is increasing at an exponential rate. To meet the demand of the user's government of India is also coming with various schemes. A lot of affordable housing needs to be constructed to fulfill these demands. To finish the project on time, within the limited budget and as well as per the requirements a new term constructability is used. The constructability talks about the integration of architecture, engineering and management. This paper includes how a building project can be seen through a constructability point of view and what are the different parameters we should take in a building project.

Keywords Project constructability · Construction

1 Introduction

India is one of the fastest developing countries. One of the important sectors in the development of India is construction. Construction sector provides a huge amount of employment. Construction industry generates about 8–10 % GDP for the government of India. Due to lot of unconventional method of construction and practices there is delay in construction project. Due to the delay the cost also increases with time. However, a lot of companies with international standards are working which

A. Shrivastava (✉) · D. Chaurasia · S. Saxena
School of Planning & Architecture, Bhopal, India
e-mail: apurv@spabhopal.ac.in

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are finishing the project as per the schedule. Some new theories and methods are developed which show that the project can be finished in a limited period of time. One of the theories which is popular nowadays is the integration of architecture, engineering and management. We use the term constructability for this purpose. "Integration of these will lead to increase in labour productivity, lower project costs, timelier project completion, to avoid claims and also to decrease adverse relationships with owner designer and contractors" [1].

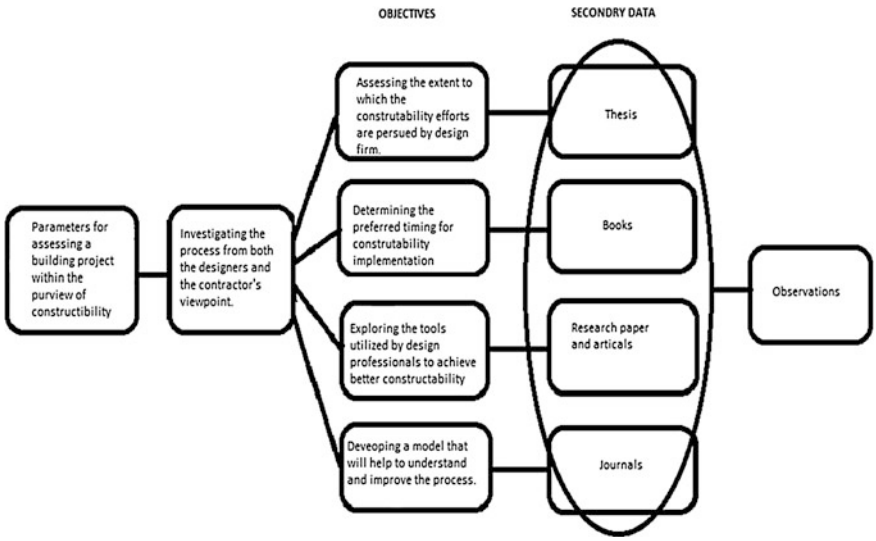
2 Why Design/Construction Integration?

As we know that there are various issues with the current patterns. It is observed by seeing various building projects that there are a lot changes in orders till the end of the project. A lot of revisions in working drawing are observed. This will ultimately result in uncertainties in time and cost. When the problem arises in a project then no one wants to take the responsibility or there is no accountability in such scenarios. So if we have a process in which we get the inputs from construction team at the beginning of the project then it will be helpful. The basic reason why we need this are to increase the labour productivity, reduce the project costs, claims should be avoided and the project should be completed in time and also "the adverse relationships between owners, designers and contractors" [1].

3 Objectives

- Extent to which the integration of architecture, engineering and management are pursued by design firms.
- The decision of integrating these three are applied at the beginning of the project, at the middle of the project or at the end of the project.
- Any software till date developed so that we can understand the integration more properly.
- Merits and demerits of integration.
- Studying the process of design from the designer and contractors point of view.
- What are the parameters we use for assessing a building project?

4 Methodology



5 Parameters in a Building Project

Various parameters on the basis which we can assess building projects are as follows:

On the basis of project delivery methods:
Construction manager at risk, Design build, Design bid build, alternate project delivery methods.

Scale of the building project:
It means what is the cost of the project or the amount of income it is going to generate from a particular project. It is of 50 lakhs, 100 lakhs or more then 1 crore (INR).

Type of the building:
Building which we are going to assess is commercial, residential, mixed use of residential and commercial or any heavy engineering buildings or godowns.

Rating System:
Building follows a rating system. The rating system is of international standards or national standards. Some of the international and national bodies in green rating system are as follows: LEED, IGBC, etc.

Location:
The site and topography also plays a major role.

6 Life Cycle of a Project

In the Fig. 1 we see that at the beginning of the project we have a very high influence in construction project from the designer point of view but less expenditure as compared to its influence but as the project progressed the influence from the designers view point decreases but from the construction point of view it increases at a very fast rate and also the expenditure also increases at an exponential rate. So we believe that with such a high influence from the construction point of view at the end of the project, so why not get the construction inputs from the beginning till the end of the project so that we should have an equal distribution of expenditure. This is the reason why we prefer constructability.

Constructability can be defined as "Constructability program aim at integrating engineering, construction, and operation knowledge and experience to better achieve the project objectives" [1].

"The Construction Industry Institute (CXI) has defined constructability as … the optimum integration of construction knowledge and experience in planning, engineering, procurement, and held operations to achieve overall project objectives" [4].

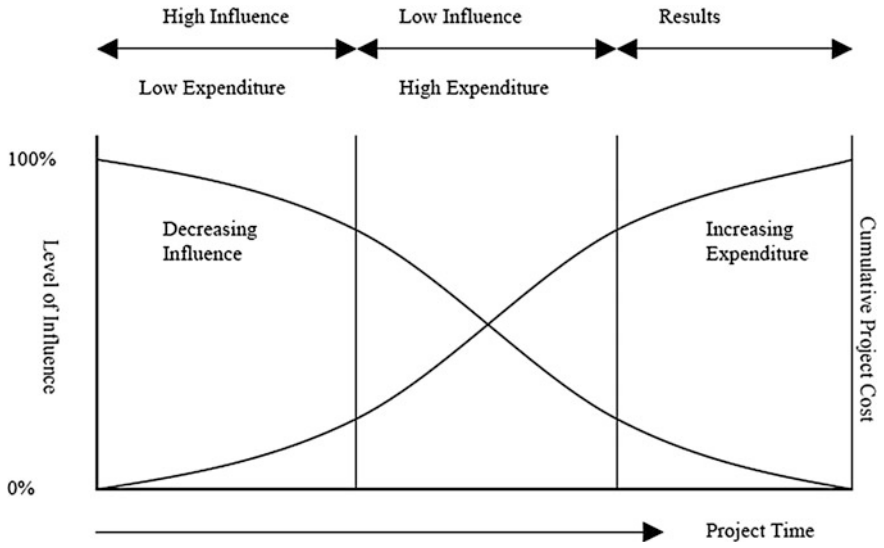


Fig. 1 Project life cycle. *Source* Fisher [3]

7 Preferred Things in the Case of Constructability

- Standardization
- Prefabrication
- Modularization
- Simple detailing
- Best use of equipments
- Best use of materials.
- The above mentioned methods which we generally follow in constructability are not preferred by various architects. As the above three mentioned above (.i.e. standardization, prefabrication and modularity) do follow a factory like sequencing. It will not have that much of new creation or innovativeness as compared to the traditional methods. It is more like a factory construction. However the other three are can be preferred by the designers and architects as the simple detailing will be helpful at the time of execution. The optimization of materials and equipments will be preferred in every case. Some more things preferred in the case of constructability are as follows:
- "Effective Site Layout
- Minimize/Avoid Return Visit
- Consider Construction Sequence
- Sufficient Tolerance
- Consider Impact of Weather
- Consider Safety
- Encourage Sustainable Construction
- Consider Innovative/efficient Construction Methods
- Provide Clear and Complete Design Information" [2].

8 Value Engineering, Construction Management and Constructability

In the beginning we thought how the constructability is different from other two as all of them talk about the cost optimization. The major differences between these three are that value engineering talks only about the cost optimization, the construction management talks about the construction optimization but the constructability talks about the overall optimization of the whole process right from the beginning from where the project was initiated till the end of the project.

9 Conclusion

The parameters in a building project can be of different types. A lot of changes in decision come within the life cycle of the project. There are different project delivery methods for different cases. However each delivery project is unique in itself. On the basis of constructability in a building we can actually optimize the whole process from design to execution. This will not only benefit the construction wing but also the architects and designers of the building.

References

1. David Arditi, M., Elhassan2, A., Toklu3, A.Y.: Constructability Analysis in the Design Firm. 10 (2002)
2. David Arditi, M., Elhassan2, A., Toklu3, A.Y.: Constructability Analysis in the Design Firm. 10 (2002)
3. Fisher, S.D.: Constructability Issues for Highway Projects (1999)
4. Van eg as Pab6n, J.A.: A Model for Design/Construction Integration During the Initial. Stanford University, vol. 1988 (1998)

Human Resource Development Intervention Towards Community Engagement: A Journey to Corporate Social Responsibility

Roziana Shaari, Zainab Khalifah, Azizah Rajab and Nor Amira Syairah Zulkarnain

Abstract This paper investigates employee perception of Human Resource Development intervention to promote awareness towards community engagement. A survey was conducted among 150 members from various units and department in Universiti Teknologi Malaysia to get their reaction, insight and views towards public commitment. Increasing social complexity and growing responsibility to society makes training human resources essential in creating and sharing knowledge that can benefit and of value not only to the common members but also the general public. This study highlights some issues for future recommendation to foster community engagement level among the university members in order to promote positive social change.

Keywords Human resource development intervention · Community engagement · Corporate social responsibility

1 Introduction

Today, Corporate Social Responsibility (CSR) has received much interest in a business concept and has been accepted widely by many business practitioners [1]. CSR has been one of the very important addition to business and it has been viewed as a key reason in dealing with competition from other business and towards achieving the company's ability to survive [1]. Organizations believe that by engaging in CSR activities may provide additional benefits such as increasing their reputation, license to operate in society and also reducing risks [2]. In the United Kingdom, since the mid 1970 there has been growing concern by the firm for

R. Shaari (✉) · Z. Khalifah · N.A.S. Zulkarnain
Faculty of Management, Universiti Teknologi Malaysia, Johor Bahru, Johor, Malaysia
e-mail: rozianas@management.utm.my

A. Rajab
Language Academy, Universiti Teknologi Malaysia, Johor Bahru, Johor, Malaysia

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ethical investment and socially responsible activities in which since then the field of CSR is believed to have been significantly enhanced [3].

The World Business Council for Sustainable Development had explained the term CSR as the involvement of business to commit activities that may contribute or give significant impact to the quality of life among the employees, families and local community. By doing this it may encourage a sustainable economic growth [4]. According to McGuire [5] CSR is defined as the actions that may bring benefit to the society which is beyond the interest of the firms and compulsory by the law. In general, CSR engagement in the organization corporate activities can be in a number of ways that include caring for the employees, protecting the environment, being ethical and also to move beyond than just for profit making by getting involve with the society [6]. Therefore, currently CSR still remains as one of the pertinent issues in environment management.

According to Asemah [7], CSR is not only restricted to business or industry sector only but may also apply to higher institution as it may impact the environments such as towards their society, stakeholders and other parties. One of the approaches for universities or industries to win reputation and goodwill is by being socially responsible to their communities [8]. However, there are doubt towards the extent of concern in higher institutions commitment towards CSR activities. Therefore, being the centres of knowledge sharing and generation, the involvement in CSR initiativies is vital for universities and they ought to extend their effort in contributiing to community development [9].

The role of university in social development and economic growth is crucial to reflect their purpose and functions in society. Finland for instance, has come out with specific changes in the university Act in which to reinforce their social role. Universities should engage and involve with their society and also to enhance and promote the effects of their social role to the research findings [10]. Moreover, the involvement of universities in such CSR activities may provide the platform for community services as universities play its role as national gateways for distribution and dissemination of knowledge, form ties internationally and influence society through the ideas and values shaped by the humanities and liberal arts [11].

2 Literature Review

2.1 University Social Responsibility and Community Engagement

Universiti Teknologi Malaysia (UTM) is a public university and was declared as a Research University in 2010. UTM has established research collaboration with renowned institutions such as Harvard University, Imperial College of London, University of Cambridge and others. In order to sustain and remain competitive UTM shall involved in University Social Responsibility (USR) to accelerate its

shared mission and purpose by establishing strong collaboration with community. Therefore, higher education administrations should direct more emphasis on this since they started to view the faculty development as a community service and outreach [12]. This is affirmed by Rubin [13] that in enhancing the engagement among university community, which includes diverse actions such as through the development of in service-learning courses and educations for citizenship, as well as widening its faculties scholarship and service through encouraging community partnership.

Universities play a critical role as problem solving to improve towards a better society as they are known as an engine of knowledge sharing and information that may aid in leading towards achieving CSR goals and objectives. However, whether universities are really committed in the CSR initiatives, the strategy employed and the degree of their commitment is still questionable [14]. In Nejati et al. [14] studies in issues relating to university's commitment to CSR had explored the annual reports and websites contents of the top 10 universities in the world. However, the result of Nejati et al. [14] study shows that all universities have played their role in seriously in reporting CSR and disclose it in their websites and also it was found that there are little changes in the way they are reporting on area of CSR covered. These core CSR areas are illustrated in Fig. 1.

The above figure shows that the role of universities in society is evolving and thus requires human resource development intervention. Due to the growing attention of HRD professional concern with ethics, integrity and sustainability have postulated HRD role in CSR [15–17] and socially responsible HRD [18]. Garavan [19] claim that the linking of the CSR with the HRD policies and practices may ensure participation of all employees in the organization and help evolve socially responsible practices [20].

2.2 Human Resource Development Intervention

Despite the abundance of literature on the outcomes of CSR, however there is still lack of explaining on how this CSR practice could be executed in an organization. Garavan and McGuire [18] stated that HRD may play significant role in this issue. Interestingly, there have been many responses in stating that human capital as a critical aspect or factor in this rapid business environment, hence HRD should take their role in creating a culture that concern more on societal issues [18].

According to Sukserm and Takahashi [21] the term "HRD for CSR" by researchers is one of the strategic development methods that act as a useful mechanism in promoting CSR in the organization. Despite of that, it may encourage employees to develop their skills, knowledge, abilities and others, in which particularly concerned in developing a more conducive mind-set.



Fig. 1 USR framework (*source* [14])

Few studies were implemented in the integration of HRD and CSR and almost silent on declaring the relationships between HRD and CSR [22]. Due to this issue, the specific contribution of HRD may be understood through a resource-based view (RBV) of the firm in which this view contends that the resources of the firm may not only represent assets but also will create the firm values. Garavan and McGuire [18] found that HRD has a significant contribution in CSR and they have proposed themes that possibly associates with employees control over, respect, diversity, responsibility, employee ethics as well as staff wellness and wellbeing.

In this study, we investigate the HRD intervention from five elements such as training and development, management support, employee engagement, employee wellbeing and performance and reward management. The development of these constructs shall be discussed in the following section.

3 Methodology

A survey using questionnaires was conducted among UTM staff to examine the role of HRD intervention in promoting CSR awareness. We employed the snowball sampling technique to identify the potential respondents since databases on staffs that involved in CSR is hardly to be maintained or recorded by UTM. We approached the UTM's Center for Community and Industry Network (CCIN) to obtain data on staff involvement in community outreach and community based participatory research (CBPR) program. The data that we gathered was then used to find further units or potential sample until the sample size is met. About 260 staff was assumed to be involved in CSR projects under CCIN from 2008 to 2014. Based on Krejcie and Morgan [23], the appropriate sample size is 152, and we distributed 155 questionnaires to identified sample.

In this study, the questionnaires used 5-point Likert scale between 1 (Strongly Disagree) to 5 (Strongly Agree). The questionnaire was developed and adapted from previous relevant literature, and the reliability was tested as shown in Table 1. The presented Cronbach Alpha value was considered preferable according to Pallant [24].

The measures used in this study were based on the definition of terms as follows:

Training and development is defined as any training or development (T&D) initiatives or efforts in improving individual specific skills or general skills that relevant to awareness in sustainability, ethics and integrity. This may include talk, formal training, workshop, discussion, campaign etc.

Management support is defined as expected role of leader in encouraging participation among employees in CSR related activities.

Employee engagement is defined as any initiatives from UTM to get UTM staff engaged in CSR activities and also their involvement with their neighborhoods or society.

Employee wellbeing is defined as any initiatives from UTM to promote and support the wellbeing of UTM community including staff and society.

Performance and reward management is defined as any initiatives that encourage or promote staff to volunteer in CSR activities.

Table 1 Summary of test reliability

Construct	Items	Reference	Cronbach Alpha (n = 15)
Training and development	12 items	Sukserm and Takahashi	0.910
Management support	8 items	Garavan [19]	0.856
Employee engagement	8 items	Mirvis [32]	0.909
Employee wellbeing	10 items	Rodrigo and Arenas [33]	0.898
Performance and reward management	7 items	Lam [28]	0.838

The data were analyzed by using the Statistical Package for Social Science (SPSS) version 16.0 Descriptive analysis, particularly percentage and mean were used to explain the results on how respondents perceive HRD intervention in promoting CSR awareness. Based on the 5-point Likert Scale, the cutting points between each scale is identified in order to establish the scoring ranges. The data were categorized into three levels, namely 1 = low (1.00–2.33); 2 = medium (2.34–3.66) and 3 = high (3.67–5.00).

4 Findings and Discussion

Generally, the respondents perceived that UTM has highly provided various T&D initiatives to promote CSR awareness (m = 4.49) (Table 2). Some training and development activities that were carried out has improving individual knowledge, skills and attitude in engaging with society (i.e. interacting with foreigner) (item 1 and 2) and make them feel proud to be engaged in CSR activities (item 9). As a result, respondents felt that UTM has also supported them in improving their CSR competency (item 5) by providing various T&D means to produce positive behavior (m = 4.56) and belief in public good (m = 4.55). This implies that specific values such as altruistic behavior, social cognition and moral judgements are important to get individual or staff involve in CSR role taking [25].

Table 2 Findings on training and development

Item	Construct	1	2	3 (%)	4	5	SD	Mean (n = 102)
1.	Ability in communicating with foreigner	–	–	–	36.3	63.7	0.48	4.63
2.	Contentment in interacting with people from a different racial or ethnic background	–	1.0	2.0	44.1	52.9	0.59	4.49
3.	Belief in public good	–		2.0	40.2	57.8	0.53	4.55
4.	Positive behavior	–		1.0	41.2	57.8	0.51	4.56
5.	Skills enhancement in CSR	–	1.0	1.0	44.1	53.9	0.57	4.50
6.	Green and ethical behavior	–	–	–	69.6	30.4	0.46	4.30
7.	Diversity culture	–	–	–	56.9	43.1	0.49	4.43
8.	Knowledge enhancement on societal issues	–	–	–	52.9	47.1	0.50	4.47
9.	Pride in CSR	–	–	–	36.3	63.7	0.48	4.63
10.	Positive emotional state	–	–	5.9	51.0	43.1	0.59	4.37
11.	Knowledge sharing culture	–	–	1.0	49.0	50.0	0.52	4.49
12.	Intention to social and economic well-being enhancement	–	1.0	2.9	48.0	48.0	0.60	4.43
								4.49

Table 3 Findings on management support

Item	Construct	1	2	3 (%)	4	5	SD	Mean (n = 102)
1.	Development of a formal policy on sustainable practices for the Community	–	–	–	41.2	58.8	0.49	4.58
2	Commitment (tangible forms) in reinforcing the right kind of behavior	–	–	1.0	37.3	61.8	0.51	4.60
3.	Managerial participation in CSR activities	–	–	1.0 1.0	37.3 41.2	61.8 57.8	0.51 0.51	4.60 4.56
4.	Performance management system measures CSR	–	–	38.2	60.8	1.0	0.50	3.93
5.	Autonomy in CSR	–	–	1.0	62.7	36.3	0.50	4.35
6.	CSR as management agenda	–	–	1.0	54.9	44.1	0.51	4.43
7.	Decision making in CSR	–	–	–	69.6	30.4	0.46	4.30
8.	CSR assessment	–	–	–	40.2	59.8	0.49	4.59
								4.52

In order to get individual or staff engaged in social responsibility, it is important to identify how UTM is perceived as supporting in ensuring CSR efforts and contribution could be institutionalized. The results in Table 3 highlighted that support from UTM was perceived to be high (m = 4.52) especially in reinforcing the right kind of behaviour in the organization (Item 2, m = 4.60). The UTM top management was expected to express their support in tangible form, and a formal policy on sustainability must be exercised (Item 1). In order to make a CSR agenda into real practice, leaders must 'walk their talk' [26], and demonstrating CSR i.e. voluntary and charitable activities (Item 3). Top management was expected to align CSR strategy in management agenda (m = 4.43) thus social responsibility values and beliefs could be promoted. This is a critical role in managing the organizational culture and climate [27] for CSR.

The following results are to measure respondents' satisfaction level towards UTM's initiatives in supporting its members to engage in CSR. The overall results in Table 4 show that the initiatives on employee engagement was high (m = 4.41). A community engagement culture is created by allowing ideas for social responsibility to be exercised (Item 1). For example, UTM provides various resources (tangible and intangible) for staff to carry out CBPR projects for community (m = 4.51). In particular, respondents were satisfied with sports and leisure facilities or activities (Item 7) provided by UTM to allow them engage in CSR (Item 5). Therefore, continuous outreach program and CBPR could be continuously offered for the benefits of community as well as volunteers. This denotes that bidirectional interactions, reciprocity, and mutual respect instead of one-way assistance would be developed. The UTM's role in promoting CSR to its members addressed the importance of HRD intervention on employee engagement. The initiatives provide avenues for its members to be able to take in charge of their work better as it may

Table 4 Findings on employee engagement

Item	Construct	1	2	3 (%)	4	5	SD	Mean (n = 102)
1.	Execution on employees' ideas	–	–	–	36.3	63.7	0.48	4.63
2.	Cooperation with community	–	–	1.0	56.9	42.2	0.51	4.41
3.	CSR platform	–	–	–	59.8	40.2	0.49	4.40
4.	CSR resources	–	–	–	48.0	52.0	0.50	4.51
5.	Volunteering efforts	–	–	8.8	52.0	39.2	0.62	4.30
6.	Social benefits payoffs	–	–	3.9	39.6	26.5	0.50	4.22
7.	Sports and leisure benefits	–	–	1.0	49.0	50.0	0.52	4.49
8.	Link between CSR and performance appraisal	–	–	8.8	47.1	44.1	0.63	4.35
								4.41

improve their quality of work-life and due to this facts employee engagement is perceived as a crucial social component of CSR [28].

Findings on the T&D initiative highlights that self-esteem and self-image were important element to be incorporated while engaging in social responsibility. Thus, HRD intervention in employee wellbeing is essential to produce constant positive behavior [29]. The results on Table 5 indicated respondents were highly perceived (m = 4.09) that UTM initiatives supported employee wellbeing. The resilience training such as critical thinking skill and problem solving skill program, ethics and moral professional, leadership skill, endurance skill and etc. were highly addressed by UTM (Item 6). However, there were also many facets still need to be improved for future practice particularly buddy system and counseling services (Item 1 and 4). In ensuring people can engage in social responsibility there are two key success factors namely competency and warmth traits [30]. Buddy system, for instance, can support individuals to produce their warmth traits including friendliness, and honesty.

Table 5 Findings on employee wellbeing

Item	Construct	1	2	3 (%)	4	5	SD	Mean (n = 102)
1.	Counseling services	1.0	7.8	20.6	48	22.5	0.90	3.83
2	Recognition	1.0	3.8	6.9	58.8	29.4	.77	4.11
3.	Mentoring	1.0	2.9	21.6	50	24.5	0.81	3.94
4.	Buddy system	1.0	9.8	17.6	50	21.6	0.91	3.81
5.	Induction training	–	2.9	3.9	55.9	37.3	0.67	4.27
6.	Resilience training	–	1.0	6.9	46.1	46.1	0.65	4.37
7.	Teambuilding activities	–	1.0	8.8	60.8	29.4	0.62	4.18
8.	Coaching	–	2.9	17.6	47.1	32.4	0.78	4.08
9.	Career planning	–	1.0	14.7	48	36.3	0.71	4.19
10.	Work-life balance program	–	1.0	9.8	59.8	29.4	0.63	4.17
								4.09

Table 6 Findings on performance and rewards

Item	Construct	1	2	3 (%)	4	5	SD	Mean (n = 102)
1.	Paid time off	–	1.0	23.5	60.8	14.7	0.64	3.89
2	Non-monetary	–	2.0	8.8	68.6	20.6	0.60	4.07
3.	Monetary incentives	–	6.9	19.6	47.1	26.5	0.85	3.93
4.	Performance appraisal (fairness and constructiveness)	–	–	12.7	55.9	31.4	0.64	4.18
5.	Seminars, workshop and training opportunities	–	3.9	10.8	66.7	18.6	0.67	4.00
6.	Promotion criteria	–	2.9	9.8	44.1	43.1	0.75	4.27
7.	Individual growth		1.0	6.9	45.1	47.1	0.66	4.38
								4.10

The following findings in Table 6 showed in general, respondents were highly perceived (m = 4.10) that UTM has recognized and rewarded their members in community engagement. According to Latham [31] employee are more motivated if there is more clear and attainable goal for them to achieve the goals as it helps them to instill purpose, challenging and meaning into work (i.e. volunteering in outreach or CBPR).

Though respondents perceived tangible rewards are also important (Item 1 and 3), unlike the corporate university's views on social actors is different [2]. Volunteering in outreach and CBPR is seen as mutual benefits and satisfaction level in social inclusion is rather valued.

5 Conclusions

University involvement in CSR or USR has been criticized to what extend their role contributed to public goodwill. This is due to the limitation that CSR by universities, mostly focusing on research, outreach program and service learning. Though their contributions through these major activities are not looking at solving others 'world's problem', but significantly demanded for sustainability. Our study highlights that universities role in CSR are crucial and continuous efforts to improve communities through their niche areas (education) has distinctive outcomes. However, lack of emprical studies on USR produce less understanding and caused the fields of CSR and university roles are marginalized and isolated. Since UTM is a research based university and have to behave in a business-like manner, they need to seriously address valuable and necessary strategy to the competitive business environment. Studies on CSR impact is highly recommended for UTM to strategize on how to obtain a true competitive advantage and a positive reputation. By having not only good reputation, CSR can help the university to contribute to the well-being of the society and gain mutual respects.

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References

1. Peng, L.M.: Internal corporate social responsibility: an overview. Aust. J. Basic Appl. Sci. **16** (8), 18–29 (2014)
2. Zain, M.M.: Corporate ibadah: an islamic perspective of corporate social responsibility. Middle-East J. Sci. Res. 225–232 (2014)
3. Mustafa, S.A., Othman, A.R., Perumal, S.: Corporate social responsibility and company performance in the Malaysian context. Procedia Soc. Behav. Sci. **65**, 897–905 (2012)
4. Lockwood, N.R.: Corporate social responsibility: HR's leadership role. SHRM Res. Quat. (2004)
5. McGuire, T.N.G.: Human resource development and society: human resource development's role in embedding corporate social responsibility, sustainability, and ethics in organization. Adv. Develop. Human Res. **12**(5) (2015)
6. Europe, C.: European Postal Services and Social Responsibilities. Brussels: CSR Europe & The Corporate Citizenship Company, vol. 48 (2001)
7. Asemah, E.S., Okpanachi, Ruth A., Olumuji, E.O.: Universities and corporate social responsibility performance: an implosion of the reality. Int. Multidiscip. J. Ethiopia **7**, 195–224 (2013)
8. Alshuwaikhat, H.M., Abubakar, I.: An integrated approach to achieving campus sustainability: assessment of the current campus environmental management practices. J. Clean. Prod. **16** (16), 1777–1785 (2008)
9. Atakan, M.S., Ekar, T.: Corporate identity of a socially responsible university–a case from the turkish higher education sector. J. Bus. Ethics **76**(1), 55–68 (2007)
10. Kantanen, H.: Civic mission and social responsibility. new challenges for the praxis of public rrelations in higher education. In; Paper presented on the 11th International Public Reletions Research Symposium, 2–4 July 2004, Lake Bled, Slovenija (2004)
11. Plantan, F.: General Report: European Sites Study Universities as Sites of Citizenship and Civic Responsibility (2002)
12. Akdere, M., Egan, T.M.: Higher Education-Community Partnerships: An HRD Perspective. Online Submission (2005)
13. Rubin, V.: Evaluating university community partnerships: an examination of the evolution of questions and approaches. J. Policy Dev. Res. **5**(1), 219–230 (2000)
14. Nejati, M., Shafaei, A., Salamzadeh, Y., Daraei, M.: Corporate social responsibility and universities: a study of top 10 world universities' websites. Afr. J. Bus. Manage. **5**(2), 440–447 (2011)
15. Lee, M.: A refusal to define HRD. Human Res. Develop. Int. **4**(3), 327–341 (2001)
16. Swanson, R.A.: Human resource development and its underlying theory. Human Res. Develop. Int. **4**(3), 299–312 (2001)
17. Valentin, C.: Researching human resource development: emergence of a critical approach to HRD enquiry. Int. J. Train. Develop. **10**(1), 17–29 (2006)
18. Garavan, T.N., McGuire, D.: Human resource development and society: human resource development's role in embedding corporate social responsibility, sustainability, and ethics in organizations. Adv. Develop. Human Res. **12**(5), 487–507 (2010)
19. Garavan, T.N.: A strategic perspective on human resource development. Adv. Develop. Human Res. **9**(1), 11–30 (2007)
20. Shen., J.: Developing the concept of socially responsible international human resource management. Int. J. Human Res. Manage. **22**(6), 1351–1363 (2011)

21. Sukserm, T., Takahashi, Y.: Self-efficacy as a mediator of the relationships between learning and ethical behavior from human resource development in corporate social responsibility activity. Asia-Pacific J. Bus. Admin. **4**(1), 8–22 (2012)
22. Martin, G.: Driving corporate reputations from the inside: a strategic role and strategic dilemmas for HR? Asia Pacific J. Human Res. **47**(2), 219–235 (2009)
23. Krejcie, R.V., Morgan, D.W.: Determining sample size for research activities. Educ. Psychol. Meas. **30**(3), 607–610 (1970)
24. Pallant, J.: SPSS survival manual: a step by step guide to data analysis using SPSS (Fourth Edition ed.) (2011)
25. Schwalbe, M.L.: Role taking considered: linking competence and performance to social structure. J. Theory Soc. Behav. **18**(4), 411–436 (2007)
26. Chong, M.: Employee participation in CSR and corporate identitiy: insight from disaster response program in the Asia Pacific. Corporate Rep. Rev. **12**(2), 106–119 (2009)
27. Schein, E.: Organizational Culture and Leadership. San Fransisco: Jossey-Bass (2006)
28. Lam, H.: HR's crucial role for successful CSR. J. Int. Bus. Ethics **3** (2010)
29. Baptiste, N.R.: Tightening the link between employee wellbeing at work and performance. Manag. Decis. **46**(2), 284–309 (2008)
30. Bauman, C.W., Skitka, L.J.: Corporate social responsibility as a source of employee satisfaction. Res. Org. Beh. **54**, 1–24 (2012)
31. Latham, G.P.: Work Motivation. Sage Publication, Thousand Oaks (2007)
32. Mirvis, P.: Employee engagement and Csr: transactional, relational and developmental approaches. California Manage. Rev. **54**(4), 93–117 (2012)
33. Rodrigo, P., Arenas, D.: Do employees care about CSR programs? a typology of employees according to their attitudes. J. Bus. Ethics **83**(2), 265–283 (2008)

Part XXI
Gender and Leadership

Is the Sky the Limit?: Leadership and Socio-economic Development of Women in the Maritime Sector in the Eastern and Southern Africa

Meenaksi Bhirugnath-Bhookhun and Momoko Kitada

Abstract Women in leadership is high on the economic agenda of all international forums as it is deemed to be an effective tool in addressing a number of socio-economic issues, namely, poverty alleviation, social well-being and wealth creation. In the case of the maritime industry, positive contributions of women are increasingly being recognised. This paper draws a particular attention to socio-economic development of women's leadership in the maritime sector. This study applies a case study method, investigating the socio-economic development in women's leadership in the Eastern and Southern Africa. An adapted model from the economic theory of the Kuznets curve is used for designing a survey of women in leadership as well as analysing their individual experiences in climbing up to leadership positions and their views on leadership in the traditionally male-dominated maritime sector.

Keywords Women leadership · Economic development · Kuznets curve · Maritime industry · Human factor

1 Introduction

In the last century, so-called, the era of neoliberal economy, a number of socio-economic problems emerged, for example, poverty, health problems and income inequalities. Within the scope of neoliberalism, the majority of decision-making in politics and economy was done in a masculinist way, which has as a

M. Bhirugnath-Bhookhun
The Association of Women Managers in the Maritime Sector in East and Southern Africa (WOMESA), Port Louis, Mauritius

M. Kitada (✉)
World Maritime University (WMU), Malmö, Sweden
e-mail: mk@wmu.se

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result accelerated the process of marginalisation of women in the labour market [1]. Economic contribution of women has been under-estimated, partly because of culture where women are positioned as domestic labour to support a patriarchal system.

Today, women in leadership is high on the economic agenda of all international forums due to various socio-economic issues, namely, poverty alleviation, social well-being and wealth creation. Effective leadership is also understood from a human factors approach to safe operations in various industries, such as hospital, nuclear, aviation and maritime sectors.

In the case of the maritime industry, positive contributions of women are increasingly being recognised. Notwithstanding, the current discussions of effective leadership in human factors are limited due to the absence of the evaluation of women's contributions to the maritime industry.

This paper draws a particular attention to socio-economic development of women's leadership in the maritime sector. The study begins with the question: what is the cost of challenges women leaders face and how does it impact sustainable issues in human factors and leadership? Is the sky the limit? Numerous barriers and obstacles associated with women leaders are identified in literature, however it is not clear how far women leaders are accepted by today's maritime industry.

This study applies a case study method, investigating the case of the Eastern and Southern Africa where one of the most active maritime women networks is located. The regional women's association, called the Association of Women Managers in the maritime sector of the Eastern and Southern Africa (WOMESA), was established in 2007 as part of the International Maritime Organization's regional support network. Thanks to their advocacy and activities to promote women in the maritime sector, an awareness of gender equality in the industry has been raised for the last decade. Despite such positive changes, the socio-economic development of maritime women in leadership positions in the Eastern and Southern Africa requires more attention and this paper intends to make a contribution to this area of research.

2 Maritime Women in the Eastern and Southern Africa

The Eastern and Southern Africa region is recognised differently by context. For example, the European Union (EU) sees the region, from their economic and trade viewpoint, consisting of Indian Ocean islands (Comoros, Madagascar, Mauritius and Seychelles), countries from the Horn of Africa (Djibouti, Ethiopia, Eritrea and Sudan) and some countries of Southern Africa (Malawi, Zambia and Zimbabwe) [2]. As an internationally recognized association spearheading the advancement of women as a key resource in the maritime sector, WOMESA draws its members

Table 1 Global Gender Gap index score (world rank*) in the Eastern and Southern Africa (selected countries in alphabetical order)

Country	Economic participation and opportunity	Labour force participation	Estimated earned income	Legislators, senior officials and managers
Ethiopia	0.608 (108)	0.90 (32)	0.61 (73)	0.36 (80)
Djibouti	N/A	N/A	N/A	N/A
Kenya	0.778 (25)	0.86 (48)	0.93 (11)	N/A
Madagascar	0.696 (59)	0.97 (7)	0.72 (37)	0.33 (86)
Malawi	0.809 (12)	1.00 (1)	0.78 (29)	N/A
Mauritius	0.534 (127)	0.61 (115)	0.42 (125)	0.31 (90)
Mozambique	0.773 (29)	1.00 (1)	0.80 (24)	N/A
Seychelles	N/A	N/A	N/A	N/A
Somalia	N/A	N/A	N/A	N/A
South Africa	0.670 (72)	0.77 (84)	0.59 (81)	0.43 (69)
Tanzania	0.709 (49)	0.99 (5)	0.93 (10)	0.20 (104)
Ethiopia	0.608 (108)	0.90 (32)	0.61 (73)	0.36 (80)
Average	0.687 (62)	0.89 (33)	0.71 (38)	0.33 (43)

(Adapted from: World Economic Forum, 2015, pp. 8–9, 52, 54, 55)* The ranking shows the country's position among the total of 145 countries listed in the Global Gender Index 2015

from 24 countries, namely, Angola, Botswana, Burundi, Comoros, Kenya, Djibouti, Eritrea, Ethiopia, Lesotho, Madagascar, Malawi, Mauritius, Mozambique, Namibia, Rwanda, Seychelles, Somalia, South Africa, Sudan, Swaziland, Tanzania, Uganda, Zambia and Zimbabwe.

According to the participants' countries in this study, the selected countries from the region are shown with their Gender Gap Indexes in Table 1. These indexes can be read as the highest possible score is 1 (equality) and the lowest possible score is 0 (inequality). It is apparent that there is a huge gap between the counties within the region in terms of women's participation in economy and labour market, income levels as well as leadership. For example, in the index of Economic participation and opportunity, Malawi shows 0.809 (ranked the 12th) while Mauritius 0.534 (ranked the 127th). Malawi and Mozambique are relatively high in global ranking, however the data about legislators, senior officials, and managers (the right column) are not available. Even women's labour force participation is relatively high in the selected countries (0.89 in average), their leadership level (i.e., legislators, senior officials, and managers) is equally low (0.33 in average). What is more concerned is that some countries, such as Djibouti, Seychelles, and Somalia, do not have data to make a comparison in the regional and international contexts. This will be a serious problem for those countries which are statistically invisible in the global discussion of sustainability and development.

3 Women's Leadership and Economic Empowerment

Many efforts have been made to empower women and stop discrimination against women both globally and locally. The United Nations (UN) adopted the Sustainable Development Goals (SDGs) and called for a special attention to gender equality in SDG 5: 'Achieve gender equality and empower all women and girls' [3].

According to the report by the McKinsey Global Institute, their "full-potential" scenario in which women participate in the economy identically to men, is estimated as adding up to $28 trillion, or 26 %, to annual global GDP in 2025 compared with a business-as-usual scenario. This impact is roughly calculated as big as the combined US and Chinese economies [4].

3.1 Is Women's Economic Empowerment Social Cost or Benefit?

Against the advocacy of women's economic empowerment, critical views tend to point out a collapse of family for the growth of nation. For example, educated women are likely to delay their family planning, therefore it contributes to less children in the country as a loss of state's assets. Such opinions emphasising women's reproductive role as their primary and ultimate contribution to social sustainability would not liberate women from domestic roles in a patriarchal system where women are subordinate to men. Feminists have been arguing that women are not social slaves of their own country and should be affranchised from that notion. The idea which considers women's economic empowerment as social cost is therefore challenged.

In the era of neo-liberal economy or globalisation, the pace of development looks faster and new technologies, such as mobile learning [5] and low-cost renewable energy [6], have contributed to women's access to and participation in formal labour markets. However, there are sectors which are still male-dominated and women find it difficult to step up their careers. The maritime industry is not an exception.

The consequences of different growth processes need to be paid more attention, especially in terms of gender equality. The maritime sector in general is still closing or not fully open its doors for women. If women are somehow systematically excluded in the process of economic development, what kind of interventions can be more effectively implemented in order to create new opportunities for future women leaders? We also need more evidences to present to the sector that women in leadership positions are too scarce to meet the sustainable development in shipping.

3.2 Investment in Women as Human Resources

Malala Yousafzai, a Nobel Peace Prize laureate in 2014, states that "We cannot all succeed when half of us are held back" [7]. Women, though they consist of half the world population, are not necessarily given the same opportunities as men in various aspects of lives, including education, employment, leadership positions, capitals and so on.

Evidences that gender equality leads to better human development outcomes for future generations have been reported from a range of countries, for example, Bangladesh, Brazil, Côte d'Ivoire, Mexico, South Africa, and the United Kingdom [8]. In South Africa, as women's shares in household earnings increase, their control over key household decisions also increased [9]. Another example is from Malawi where fairly small cash transfers to girls increased enrollment and reduced dropout rates [10]. The recent study from the Harvard Business School also reveals that daughters of working mothers were more likely to be employed, receive higher earnings, and hold supervisory roles in 24 countries they investigated [11].

On a larger scale, the relationship between gender equality and economic growth has been examined by various studies, for instance, the World Economic Forum's index of economic participation and opportunity [12], using large cross-country data. It is argued that analysing the linkage between gender equality and growth is not an easy task, because the interpretation of such data can go in both directions. Nevertheless, there is a consensus from the evidences of research that gender equality and growth are correlated and that gender equality matters for many aspects of growth [13]. Hence, a further effort to develop a methodology to examine the relationship between economic development and gender equality needs to be encouraged in various parts of the world.

3.3 Kuznets Curve for Analysing Gender Equality

To echo a call for research in economic development and gender equality, Eastin and Prakash developed the S-shaped model of the relationship between economic development and gender equality (Fig. 1) [14]. Kuznets curve is based on the

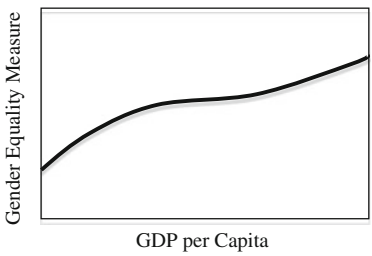


Fig. 1 S-shaped gender equality measure model of Kuznets curve (Adapted from: Eastin and Prakash [14])

hypothesis that as an economy develops, economic inequality first increase and then decrease. Kuznets's work was later extended to the application of environmental analysis [15]. Eastin and Prakash found that economic development and gender equality have a curvilinear relationship: a discernible S-shaped gender Kuznets curve. It roughly presents three stages of economic growth: (i) Economic growth facilitates a relative improvement in gender equality; (ii) Social and cultural institutions endogenous to economic development process limit gains; and (iii) Economic development diminishes the institutional desirability of gender discrimination and shifts towards gender equality.

4 Methods

4.1 Case Study Approach

The socio-economic development of maritime women in leadership is viewed as human factors in this research, because women's active participation in leadership and decision-making positions affects the 'man-made' system of the maritime industry. The research employs case study methods and looks into the regional case in the Eastern and Southern Africa. Ontologically speaking, a case study reveals essential truths about the human condition in a singular, particular, and unique form, which may potentially recognise a universal truth [16]. The norms of gender varies by culture and context where one belong. Therefore, case study methods are particularly suitable for understanding the meaning of gender which is locally shared and practised.

The case of maritime women in the Eastern and Southern Africa still contains a wide range of 'differences', however the issue of 'sameness' in women's economic development has been also shared in the region. WOMESA has been playing a critical role in women's agenda in the region for almost 10 years. This claim is accepted as the particular relations among theory, practice, and research will be shaped by the context in which they are located [17].

4.2 Survey Design

In this study, an adapted model from the economic theory of the Kuznets curve is applied for designing a survey of women in leadership as well as analysing their individual experiences in climbing up to a leadership position and their views on leadership in the traditionally male-dominated maritime sector. With a closer look at Kuznets curve, this case study examines where the current status of economic development of maritime women in leadership in the Eastern and Southern Africa stands in the S-shaped gender Kuznets curve.

4.3 Data Collection

The human condition of women leaders is better captured by their narratives which tend to be qualitative. In particular, a feminist research method emphasises a qualitative approach [18] and this view was reflected when designing a survey, asking the participants to answer various types of questions, including multiple-choice and open-ended questions. A pilot survey was conducted in the process of finalising the questions to make sure that they were appropriately placed.

The recruitment of participants was made through both public and private networks of the author in early 2016. In order to reach out more participants, a survey was prepared in two formats of the same contents: a printed survey on paper; and an online survey. The author attended an annual conference of WOMESA where a paper survey was distributed. In total, 36 responses were collected for analysis. The majority (n = 34) replied via a paper survey and only two returned through an online survey. Participants' countries include Ethiopia (n = 6), Mauritius (n = 4), Kenya (n = 3), Tanzania (n = 2), South Africa (n = 2), Malawi (n = 1), Madagascar (n = 1), Mozambique (n = 1), Seychelles (n = 1), Djibouti (n = 1), Somalia (n = 1), and no answers or others (n = 13). Most participants fell into the age category of their 30 s (n = 13), 40 s (n = 10), or 50 s (n = 8).

5 Results

In order to analyse the inputs of the participants drawn from a spread of contexts, the phenomenological approach [19] was adopted to identify key themes and issues in each text. Irrespective of socio-economic background, reported experiences as maritime women leaders unfurled a number of similarities as well as striking differences.

Fifty percent of the population perceived their experience as maritime women to be quite tough as they had to work harder to affirm themselves. This is in turn to the detriment of their individual self and eventually family life. The remaining fifty percent who climbed the ladder in spite the odds seemed to have enjoyed the experience and described it as being fulfilling. Overall, the majority of the respondents the maritime leadership is a challenging journey.

The challenges faced by maritime women was broadly classified under three main themes, namely, the inherent nature of the sector to-date, which is predominantly the preserve of their male counterparts (i.e., associated challenges of struggling in a male-dominated sector); the persistent lack of recognition for their contribution to the development of the sector; and ultimately, capacity-building. On being questioned further, it was pointed out that had there not been targeted capacity-building programmes at regional and international levels, the majority of the respondents would not have achieved their respective positions as maritime leaders.

The financial implications in attaining positions of maritime women was not deemed to be as pertinent as was the costs in terms of the extra time and energy having to be deployed to live up to the acquired positions. This in turn had a spill-over effect on the other aspects of lives of the maritime women. Mentorship programmes and networking were deemed crucial in attenuating the resulting externalities.

Seventy-five percent of the respondents felt that there was no work-life balance. The main reasons were observed to be the self-prejudice *vis-à-vis* maritime women coupled with cultural concerns. The deep-seated inclination to go the extra mile to affirm oneself as a maritime women often resulted in more time being devoted to the same work than that which would have been devoted by male counterparts. On the other hand, 25 % of the maritime women who apparently have a work-life balance seemed to be drawn from the countries experiencing high economic growth.

The vast majority of the respondents firmly believed in family as an institution. Family is deemed to offer the small frame for socio-economic development. As such, the cumulating small frames makes up the ultimate structure which is society. Family and parenthood were highlighted as fundamental roles of human beings towards the sustainable development of the society at large.

Additionally, the respondents averred that there was no cost to society and if ever there were costs, they were actually positive costs. However, ensuing discussions on the written replies revealed that their responses were in fact subjective. Late marriages, divorces or single parenthoods were common incidence that maritime women incurred in pursuing their career. In their competitive climb-up the career ladder race, at times maritime women tend to neglect some fundamental duties. Men should then be encouraged to care and support women in their endeavours done and not condemn them.

Surprisingly, significant differences were noted across the WOMESA Member States in terms of policy measures and stance with respect to maritime women empowerment. In countries like Somalia, Eritrea, Sudan and Djibouti, the strategies for maritime women empowerment were reported to be quasi non-existent, while in countries like South Africa, Kenya, Seychelles and Mauritius, maritime women in leadership were encouraged. Training/Continuous Professional Development courses, fellowships and exchange programmes promoted capacity-building whilst retention strategies included in-house support systems, namely, entitlements such maternity leaves, flexible hours of work and child-care facilities amongst others.

All of the above, with the S-shaped Gender Equality Measure model of Kuznets curve, there needs to be more investigation to depict the situations of which maritime women leaders in the Eastern and Southern Africa commonly share the issues relating to maritime women and leadership. Though there is a limitation in data, the phenomenological analysis of narratives by the participants could provide an insight. Some countries may be still in the first stage of economic growth, showing a relative improvement in gender equality, while other countries can be in the second stage where sexual stratification and discrimination against maritime women leaders limit women's advancement.

6 Conclusion

This case study of women leaders in the maritime sector in the Eastern and Southern Africa, therefore, provides a new insight to an academic debate on human factors and leadership from women's perspectives, with a particular focus on women's leadership in the maritime industry. The results of the survey hinges that the prevailing socio-economic environment of a country impacts on the evolving maritime women and the associated costs.

Every human being, irrespective of gender, should be aware that we all have a personal and work life. For social sustainability it is important to have the right balance as personal and work life, they both exist and coexist. As such, in the long term, men and women working together, hand in hand as a family will be instrumental in fostering the sustainability of the maritime sector. However, policy-makers should exercise caution in designing the proper delimitation. The suggested measures should look into establishing the requisite balance between the different spheres of life of the maritime labour force by resorting to a gender-based yet not gender-biased approach apt for the predominant context.

The likely limitation in this study is that it is more inclined towards qualitative analysis, whilst economic development is often measured by quantitative data, such as income level. The study depicts an overview of the existing situation within the maritime industry across the Eastern and Southern African region, whereby on average a representative reflects the condition of the country as a whole, which again may be questionable.

Additionally, the socio-economic development of the countries across the Eastern and Southern Africa is not varied to an extent which allows an in-depth analysis of the adapted Kuznets curve theory. To this end, it is suggested that future research should focus on country-based study and subsequently consider a comparative study with other countries outside the Eastern and Southern Africa, to allow a more proficient application of the adapted Kuznets curve theory.

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References

1. Eisenstein, H.: Feminism Seduced. How Global Elites Use Women's Labor and Ideas to Exploit the World. Paradigm Publishers, Boulder (2009)
2. European Union: Eastern and Southern Africa (ESA). http://ec.europa.eu/trade/policy/countries-and-regions/regions/esa/. Accessed 01 March 2016
3. United Nations: Sustainable Development Goals. http://www.un.org/sustainabledevelopment/sustainable-development-goals/. Accessed 01 March 2016
4. McKinsey Global Institute: The Power of Parity: How Advancing Women's Equality Can add $12 Trillion to Global Growth. Executive Summary. McKinsey Global Institute, Chicago (2015)

5. West, M., Chew, H.E.: Reading in the Mobile Era: A Study of Mobile Reading in Developing Countries. UNESCO, Paris (2014)
6. Köhlin, G., Sills, E.O., Pattanayak, S.K., Wilfong, C.: Energy, Gender and Development: What are the Linkages? Where is the Evidence? A background paper for the World Development Report 2012 on Gender Equality and Development Paper No. 125. World Bank, New York (2011)
7. A World at School: Malala Yousafzai's speech at the Youth Takeover of the United Nations. Theirworld, London (n.d.). https://secure.aworldatschool.org/page/content/the-text-of-malala-yousafzais-speech-at-theunited-nations/ Accessed 01 March 2016
8. The International Bank for Reconstruction and Development/The World Bank: Getting to Equal: Promoting Gender Equality through Human Development. World Bank Group, Washington (2011)
9. The International Bank for Reconstruction and Development/The World Bank: World Development Report 2012: Gender Equality and Development. World Bank Group, Washington (2011)
10. *Ibid*
11. McGinn, K.L., Castro, M.R., Lingo, E.L.: Mums the Word! Cross-national Relationship between Maternal Employment and Gender Inequalities at Work and at Home. Harvard Business School, Brighton (2015)
12. World Economic Forum: The Global Gender Gap Report 2015. World Economic Forum, Geneva (2015)
13. The International Bank for Reconstruction and Development/The World Bank: World Development Report 2012: Gender Equality and Development. World Bank Group, Washington (2011)
14. Eastin, J., Prakash, A.: Economic development and gender equality: is there a gender kuznets curve? World Polit. **65**(1), 156–186 (2013)
15. Grossman, G., Krueger, A.: Economic growth and the environment. Quart. J. Econ. **110**(2), 353–377 (1995)
16. Rule, P., John, V.M.: A necessary dialogue: theory in case study research. Int. J. Qual. Methods 1–11 (2015)
17. *Ibid*
18. Maynard, M.: Methods, practice and epistemology: the debate about feminism and research. In: Maynard, M., Purvis, J. (eds.) Researching Women's Lives from a Feminst Perspective. Taylor & Francis, London (1994)
19. Moustakas, C.: Phenomenological Research Methods. Sage, London (1994)

Globalization Strategies and Higher Education. A Dutch—Romanian Perspective

Florentin Popescu

Abstract Higher education institutions throughout the world are undergoing considerable functional and structural changes as they adapt to meet the needs of a global and knowledge-based economy. There is an urgent call for them to be equipped with an well-defined and implanted globalization strategy to tap and provide useful and simple planning tools to utilize global resources effectively. In this sense, this paper seeks to investigate the problem of how and why HAN University of Applied Sciences (The Netherlands) and Bucharest University of Economic Studies (Romania) have responded to globalization within the context of their strategic planning and their local, regional, national and global roles and responsibilities. It seeks to document how these aspects of globalization are perceived by the both universities faculty and higher management. The paper traces the chosen universities recent development and seeks to account for this in terms of their institutional strategic planning.

Keywords Higher education · Globalization strategy · Global competitiveness · Institutional strategic planning · Institutional policies development · Global university

1 Introduction

This paper seeks to highlight major issues in connection with institutional responses to the impact of globalization with respect to responsibilities that range from being local to global in nature. Continuing, it explores higher education in the context of

F. Popescu (✉)
HAN University of Applied Sciences, Ruitenberglaan 31,
6826 CC Arnhem, The Netherlands
e-mail: florentin.popescu@han.nl

F. Popescu
Bucharest University of Economic Studies,
Piata Romana Nr.6, Sector 1, Bucharest, Romania

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globalization, with a particular emphasis on academic motives for globalization and its part in the response to opportunities presented by globalization shown by the universities. The researcher is planning to encompass a consideration/evaluation of the specific country government policies and practices in relation to the theme as well as an evaluation of institutional responses of HAN University of Applied Sciences (The Netherlands) and Bucharest University of Economic Studies (Romania) to a range of issues, policies and strategies concerning globalization. Possible the extent of study is wider and includes other responses to globalization such as academic relevance and quality, curriculum development, mobility of programmes, and so forth.

2 Academic, Societal and Institutional Contribution to Knowledge

This paper contributes to knowledge by attempting to quantify how and why some universities are striving to take advantage of the opportunities presented by the impact of globalization and consequently to increase their global competitiveness. It positions the responses to globalization of chosen universities within the policy context that each university sets. In a world that is globalizing rapidly, in which the central role of universities in the knowledge economy and in civil society is articulated more strongly and more widely than ever, we do not have a clear sense of what it takes or what it means to be a global university [31]. This paper strives to contribute to this discourse. In a conceptual context, this research is exploring the various tiers of globalization and to equate them to the overall responses to globalization from the context of institutional strategic planning made by the different universities.

3 Globalisation and Higher Education

The changes that have taken place in higher education globally over the last few years can be referred to as a revolution [2]. Globalization and internationalization are today major drivers of change in higher education systems globally [20]. Matthews and Sidhu [26] argue that international education is a direct manifestation of globalization, concentrating their study only on its economic drivers, an interpretation that is lacking the direct response to globalization. While national and international strategies for remodeling existing methods and instruments of higher education management must develop [7, 11, 29, 35, 36], a drastic change of responsibilities and resources has to consequently shift towards a common model of higher education [5, 28, 34].

There is a vast body of studies dealing with different aspects of higher education development in context of national economies globalization and societies integration. Although all these studies are focused on different issues and their results vary from country to country, nevertheless they all can be placed within the following scheme: they either (1) investigate the nature of globalization and integration in field of higher education or vice versa, that is, the role of higher education in promotion of national economies globalization and societies integration; or (2) analyze attributes and challenges imposed by integration of national universities into world system of higher education; or (3) study actions undertaken and policies conducted by national governments and managements of local universities to prepare and adjust national higher education for its integration into world system of higher education [21].

Studies focusing on nature of globalization and integration in context of higher education often try to identify and analyze a nexus between these three elements. In particular, they consider higher education in context of globalization and integration as: (1) as a system of functionally dependent universities and R&D institutes, or universities and institutes from different countries that are bound together by different frequent interactions, e.g. exchange student flow, R&D cooperation etc., across national borders; or (2) as groups of national universities and institutes that share values and beliefs that transcend national systemic boundaries [4, 10].

As for globalization of national higher education from emerging market economies, such studies confirm general worldwide tendencies described above and additionally analyze the role of international organizations such as OECD and UNESCO in transforming local systems of higher education in accordance with world accepted standards and best practices [12, 15].

Other studies focusing on crucial role of higher education for maximizing the benefits of national economies globalization and societies integration state that cooperation between universities and R&D institutes increases wealth of societies and promotes international cooperation between nations [25]. Studies analyzing attributes and challenges imposed by integration of national universities into world system of higher education work with such attributes as cross-border collaborative arrangements, knowledge and language acquisition, adoption of curriculum with international content etc., and connected with them challenges such as building up of knowledge economy and technology, establishing of lifelong learning, challenges of governance and financing of universities in accordance with the Lisbon Strategy etc. [3].

Finally, studies focusing on actions undertaken and policies conducted by national governments and managements of local universities mainly focused on organizational issues, that is, they analyze the appropriateness of the existing landscape of national higher education to tackle the challenges imposed by integration and try to find the correct degree of autonomy of national higher education institutions under internationalization and globalization [25]. In addition to educational issues, political and economic aspects are involved in the process of globalization and regionalization of higher education [16].

The Governments and Universities are implementing the variety of policies and programs to respond to globalization. These typically include sending students to study abroad, setting up a branch campus overseas, or engaging in some type of inter-institutional partnership. Higher education systems, policies and institutions are being transformed by globalization, which is "the widening, deepening and speeding up of worldwide interconnectedness" [14]. The different higher education reforms and instruments are growing and developing [23, 30, 33], therefore the transformation of higher education can also be motivated by the impact of globalization with direct influence on the educational motives and institutional strategic management decisions of those institutions. Given resource constraints and different institutional missions, not all universities will try to achieve global competence; but at a minimum they should try to attain global understanding [1, 17].

As Bradley Cook mentioned in his review on trends in education, the globalization theme in comparative education studies is most commonly used [9]; a theme that is not adequately accounted for in the literature. This gap has been partially filled in by University of Bath School of Management doctoral thesis of Sally-Ann Burnett [6]. This study explores how chosen universities, have responded or, should respond, to the impact of globalization on the academic motives of their educational programmes. It examines the globalization context and the processes and priorities in institutional responses that affect the short and long term global managerial strategies. Nevertheless there is one good reason for this research to look into a more specific area of academic motives and strategic globalization strategies.

4 Problem Definition & Research Design

This paper traces the chosen university recent development and seeks to account for this in terms of institutional strategic planning. It seeks to document how these aspects of globalization are perceived by university administrators and faculty. In addition, this paper highlights some of the major issues in connection with institutional responses to the impact of globalization with respect to responsibilities that range from being local to global in nature. In particular, culture and strategic planning are explored, as the literature shows that these aspects of universities are critical in identifying reasons for institutional responses of complex organizations, such as universities. The research questions addressed in my research evolve from the literature review that demonstrates a gap in the literature specifically to do with individual university responses to globalization. There is a lack of empirical research in this field hence the author is keen to add to the research and quantify such activity.

It is acknowledged that institutional strategic planning relevance is a small part of globalization and this is used as the anchor point for case study interviews. This research is designed from a point of curiosity hence it is important that there is a starting point for discussion on the impact of globalization and what it means at each case study university. This however, does not limit or hinder the discussion.

Still, the choice of data collection methods is also subject to constraints in time, financial resources, and access. For the purposes of the case studies within the thesis of which this paper is a part of, and interviews to be carried out, globalization is taken specifically to be 'the activities undertaken to fulfil the goal of increasing the global dimension of the institution.

In line with the explorative nature of the study, the goal of the interviews was to see the research topic from the perspective of the interviewee, and to understand why he or she came to have this particular perspective. To meet this goal, King [18] recommends that one have "a low degree of structure imposed on the interviewer, a preponderance of open questions, a focus on specific situations and action sequences in the world of the interviewee rather than abstractions and general opinions."

In line with these recommendations, I chose a combination of interviews, archives, and observation, with main emphasis on the first two. Conducting a survey was inappropriate due to the lack of established concepts and indicators [32, 37]. The reason for limited observation, on the other hand, was due to problems in obtaining access early in the study and time and resource constraints. In addition to choosing among several different data collection methods, there are a number of choices to be made for each individual method. When relying on interviews as the primary data collection method, the issue of building trust between the researcher and the interviewees becomes very important. I addressed this issue by several means and I established a procedure of how to approach the interviewees.

Policy and other documentation for each university was collected on site, to supplement the primary and secondary data gathered, when made and recorded. For the national policy context, sources of documentary information were used to gauge the international, national and local position on higher education in selected universities. Several government and other websites were used to glean policy and positional information. Sources referenced in research papers were also utilized as resources from online searches through various electronic databases and search engines. The documentation from institution for each of the case studies was collected to gain an insight into each institution and the strategies and policies in place. Sources of this information may include: strategic plans; management and academic structure charts; annual reports; internationalization policy documents; websites etc. These documents are the first types of units of observation for each of the case studies.

5 Higher Education Policies in Romania and the Netherlands

Institutional arrangements set by national governments serve as the principle factors in shaping the dynamics of both structuring, regulating and financing where the government is a dominant factor influencing higher education institutions. Within

the context of the Romanian Higher Education, key policies and legislations were developed and can be summarized as follows: the Law of National Education (Law nr. 1/2011); the Constitution of Romania (passed in 1991); the organic law of education (Education Act 84/1995); common specialized laws (Act 88/1993 regarding the accreditation of higher education institutions and the recognition of university diplomas and the Act regarding the Statute of the Teaching Staff no 128/1997); government decisions having the force of Acts of Parliament over an established period and different Orders of the Minister of Education. Devised as a strategy to "remove the last vestiges of communist heritage" [24], the Ministry's reform package not only aimed to put an end to the transition phase and bring the education system more in tune with socio-economic needs, but also to bring Romania closer to western European points of reference [24].

Romania has made major steps towards the European Higher Education Area by reorganizing the entire higher education system in 2005. Still, the importance of the existence of a strategy for higher education that promotes a strategy for higher education that must be correlated nationally with the strategy for research and development aiming to obtain autonomy for higher education institutions is a must. To meet this objective the Romanian higher education system should attract diverse sources of funding, including partnerships with firms, partners that will finance the research and development activity in the domains they are interested in. Having financial autonomy is a fundamental aspect of the current tendencies in the higher education governess.

The new Law of National Education, which came into effect in February 2011, paves the way for the diversification of university missions and for a better use of resources for advanced university research. All Romanian universities, state and private, are classified in three categories according to their prevailing missions: (1) educational universities, (2) education and research universities, and (3) advanced research and education universities. On the long term, to achieve the targets set by the Europe 2020 the Romanian Higher Education Institutions (HEIs) need to improve the quality and increase the investments in education, vocational education and training. Also, it is necessary to increase the mobility of students and teachers to improve the quality of teaching.

The Dutch HEIs are subject to the rules and regulations of the Dutch Higher Education Act (WHW—BWBR0005682). They are obligatory signatories to the "Code of Conduct for international students in higher education" if they wish to recruit students outside the EU/EEA or Switzerland. Other relevant legislation includes the Aliens Decree 2000 and Chapter B3 of the Aliens Act Implementation Guidelines 2000. Effectively, the immigration authorities generally accept the decisions of HEIs as to the admissibility of foreign nationals as bona fide students. Non-compliance with the Code of Conduct can lead to revocation of the admissibility status.

The quality control mechanism for educational delivery throughout the entire system consists of a cyclical accreditation (at the institutional level and/or programme level) under the auspices of the Accreditation Organization of the Netherlands and Flanders (DFAO a.k.a NVAO). This is in effect a managed

peer-review system. The same organization has created a special audit procedure to be able to award, inter alia, a special distinction to programmes (or institutions) for having achieved a high level of internationalization.

6 Results & Outcomes

Besides the interviews held at the Bucharest University of Economic Studies (BUES), a number of internal and external planning documents were used, including the BUES Institutional Evaluation Programme 2012, Self- Evaluation Report 2012, BUES Development Strategy 2011–2020, the Institutional Project on "Development Strategy and Increasing the Competitiveness of BUES" 2014–2020, Self-Evaluation Quality Control Report 2013–2014, BUES Students Independent Report on Quality Assurance 2014–2015, Action Plan (to increase the international visibility of the university/faculty and attract foreign students) 2014–2015.

From the key documents mentioned above (Self- Evaluation Report and the Development Strategy 2011–2020 the university's version is as follows: "BUES aims to hold a leading position in the field of economic and administrative sciences in the classification of universities from Central and Eastern European countries and to achieve high competitiveness in the European and international area for all the undergraduate and postgraduate study programmes it provides. This vision is based on promoting an authentic quality culture, on creating, disseminating and capitalising on top knowledge, the proactive involvement of all the members of the academic community, and on encouraging functional entrepreneurial partnerships which bring national and international benefits."

The above two key documents also outline the mission of the BUES and its strategic goals which in fact reflect the intended profile of the BUES as:

- A university of advanced research and education
- An entrepreneurial university
- A university with a high degree of motivation and performance
- A sound work environment that generates high performance in education and research
- A university with international visibility
- A university respecting fundamental human values: morality, ethics, human beings, honest, well-done work, the environment.

Regarding the HAN University of Applied Sciences polices and internal documentation, the following internal and external planning documents were used: the Strategic Research Policy Plan 2012–2016, HAN Development Plan 2012–2016 (Reflection on trends and future HAN external partners, Lectors Meetings Reports, The Education Chapter, Employees and Students Meetings Reports, Trend Analysis), The Future of the HAN 2016–2020, Learning and innovation: working

together in trust and confidence—HAN ambitions for 2016–2020 and the HAN Institutional Plan 2016–2020.

HAN University of Applied Sciences holds paramount its responsibility to contribute to the development of society. As such, HAN is strongly committed to promoting and sharing knowledge and skills, and to making these available to a wider audience. They achieve this by:

- Providing superior quality education while adhering to a code of conscientious and responsible professional practice
- Striving towards sustainability in all that we undertake
- Ensuring that our employees act with personal integrity and social responsibility
- Embodying our core values of involvement, responsibility, ownership and professional identity
- Working on the basis of honesty, trust, and clear, concise agreements

The significance and urgency of examining the relationship between governmental policies and higher education growth patterns and strategies is something that scholars need to address. Among universities, motivations for globalization vary substantially, and often they reflect the culture of the school and its management or the pressures applied by stakeholders. In many cases, multiple motivating factors originate from the school itself, the business community that it serves, and/or the country/region in which the university is located. The AACSB globalization report mentions that schools focus on globalizing the learning experiences of students, but often neglect to put the same emphasis on ensuring faculty have global developmental opportunities [1]. As from the interviews and discussions with the management of both universities the global developmental opportunities are actually one of the motives for globalization strategies that both institutions are implanting.

Bucharest University of Economic Studies strives to ensure openness, promoting cooperation with partners in Romania and the world's most excellent centers of higher education and research; while the HAN University of Applied Sciences takes active measures to further internationalize the institution and development of research and new national and international study programme. They also provide international orientation courses by involving lecturers from foreign higher education institutions. Hall [13] asserted that it is as important for faculty members to teach abroad as much as it is for students to study abroad. He states that he learned important pedagogical, research-related, and life lessons from his teaching abroad experiences that he could not have learned otherwise.

This sentiment is corroborated by a study by Finkelstein and Chen (cited in the AACSB Report, [1], which found a positive correlation between a faculty member incorporating international issues into the classroom and the amount of time the faculty member had spent abroad after earning an undergraduate degree. Clark and Arbel [8] noted that to globalize faculty, universities should require more international faculty exchanges and sabbaticals, have more international faculty members and use industry professionals with global experience in the classroom.

In this sense, HAN University of Applied Sciences has initiated programmes to attract foreign and other higher educational institutions professors as guest lecturers for teaching internationally related subjects and took necessary steps for ensuring the further training for the academic staff, including participation of lecturers and students in international seminars, workshops, conferences as well as exchange programmes. They also looked for both new opportunities for participation in international projects and joint research as well as organized scientific international conferences to encourage student participation on regular basis.

One of the many ways in which HAN displays its international focus is through international projects. Each faculty has its own specific cross-national initiatives. Some international projects are HAN-wide and include students and teaching staff from all faculties. A striking example is the community project in Theewaterskloof municipality, South Africa, where students and staff of HAN University of Applied Sciences and the University of the Western Cape in South Africa help local communities to develop small businesses. The project gives students a once-in-a-lifetime learning experience while at the same time making a very valuable contribution to society. Because of the multidisciplinary nature of the project, all the departments at both universities are involved in carrying out project activities, teaching or doing research.

Over the past 2 years, 111 students have worked in Theewaterskloof on 59 different projects. Most of these are multi-year, multidisciplinary projects, focused mainly on education and health. Some examples are:

- A project where students in the fields of industrial design, psychotherapy and speech therapy work together to design toys for children with a mental health disorder
- An education project in Genadendal, where students of education, social work, physiotherapy and occupational therapy together support home-based care programmes for a local elementary school
- A project in Grabouw that allows students in the fields of built environment, educational theory and industrial design to build outdoor play equipment while simultaneously helping teaching staff

Globalization reshape how universities are positioned relative to one another and differentiate themselves in this environment, therefore their responses to globalization differ along lines that define strategy and the strategic position of an institution including reputation, mission, and resources. Regardless, the economics of globalization will have a tremendous impact on the future of globalization, and the answers may depend on specific characteristics of the university and national and international policies.

Globalization has led to growth in interdependence, interconnectedness and mobility across global communities, making global challenges and achievements transcend national boundaries [22]. It is not surprising that sustainable solutions to emerging global development problems cannot be found through efforts and resources confined within one locality [27]. In this evolving context, partnerships

across national and disciplinary boundaries are rapidly emerging as the dominant model for organising international research and development [19].

The AACSB Globalization Report noted three dimensions of faculty strategies for globalization: recruit, develop, and manage. To foster globalization, business schools recruiting strategy should include recruiting faculty that have interest in international issues. An additional recruiting strategy would be to recruit faculty who have international knowledge, perspectives, or experiences. A third recruiting strategy would be to recruit faculty for the international connections, for example, recruiting a faculty member that is currently working in a foreign university [1]. In this light

Regarding the above mentioned faculty strategies for globalization, Bucharest University of Economic Studies is actively engaged in the development of scientific research infrastructure by participation in research projects' competitions by developing defined key scientific research directions through cooperation with international higher education and research institutions. The University has concluded research agreements with various partners from Romania and abroad, including bilateral agreements. Here are the main funding sources for the research projects undertaken at University level: Framework Programme 7; Bilateral Agreements; COST (European Cooperation in Science and Technology); CERGE (Center for Economic Research and Graduate Education); EUREKA and the European Social Fund - SOP HRD projects. The University aims to maintain excellence in research by undertaking scientific research projects and topics in co-operation with other national and international education and research institutions, as well as within research networks and consortia. To perform scientific research activities, the University's research teams have benefitted from the cooperation of leading international figures in their respective fields.

By illuminating the strategies, practices, and social impacts of business globalization, management educators not only can accelerate it, they also can help ameliorate its costs and disruptions. Better international management education promotes more responsible globalization in business and society.

7 Conclusions & Further Research

Globalization reshape how universities are positioned relative to one another and differentiate themselves in this environment, therefore their responses to globalization differ along lines that define strategy and the strategic position of an institution including reputation, mission, and resources. Regardless, the economics of globalization will have a tremendous impact on the future of globalization, and the answers may depend on specific characteristics of the university and national and international policies.

This paper suggests that globalization is changing former assumptions, practices, and strategies. Among the universities studied, globalization was motivated by strategic objectives related to many trends within the global business and economic

environment as well as those related to globalization trends within national higher education. After summarizing the findings of the interviews at the university and the analysed strategic objectives and national policies I find that universities globalize for many reasons: to secure their position in the higher education market, to improve international competitiveness, to gain wider international recognition, to facilitate the development and growth of the institution, to be allied with the national agencies for higher education quality assessment, to increase and promote internationally accredited study programmes, to improve quality of research to raise the quality of study programmes, to produce for the corporate goal of improving the universities international rating through publication in international journals, to diversify research resources, to provide international orientation courses and to increase the number of international students.

It is essential that universities have a well-defined globalization strategy plan which reflects a culmination of a series of discussions amongst stakeholders presenting an integrated action plan for the implementation of the strategy that deliberately look into the opportunities and challenges that globalization poses to higher education.

References

1. AACSB: The Globalization of Management Education: Changing International Structures, Adaptive Strategies, and the Impact on Institutions (2011)
2. Altbach, P., Reisberg, L., Rumbley, L.: Trends in Global Higher Education: Tracking an Academic Revolution Sense/UNESCO. Rotterdam (2010)
3. Altbach, P.G., Knight, J.: The internationalization of higher education: motivations and realities. J. Stud. Int. Educ. **11**, 290–305 (2007)
4. Amaral, A., Neave, G., Musselin, C., Maassen, P.: European integration and the governance of higher education and research. Higher Educ. Dynam. **6**, 11 (2009)
5. Bleiklie, I.: Towards European convergence of higher education policy? Higher Educ. Manage. **13**(1), 9–29 (2001)
6. Burnett, S.A.: The impact of globalisation on higher education institutions in Ontario. Thesis (Doctor of Business Administration (DBA). University of Bath (2008)
7. Cerych, L., Sabatier, P.: Great expectations and mixed performance: the implementation of higher education reforms in Europe. European Institute of Education & Social Policy, Stoke-on-Trebt (1986)
8. Clark, J.J., Arbel, A.: Producing global managers: The need for a new academic paradigm. Cornell Hotel Restaurant Adm. Quart. **34**(4), 83–89 (1993)
9. Cook, B., Hite, S., Epstein, E.: Discerning trends, contours, and boundaries in comparative education: a survey of comparativists and their literature. Comp. Educ. Rev. **48**, 123–149 (2004)
10. Elken, M., Gornitzka, A, Maassen, P., Vukasovic, M.: European integration and the transformation of higher education. University of Oslo research paper, p. 57 (2011)
11. Goedegebuure, L., Kaiser, F., Maassen, P., Meek, L., van Vught, F., de Weert, E.: Hochschulpolitik im internationalen Vergleich: eine länderübergreifende Untersuchung im Auftrag der Bertelsmann Stiftung. Bertelsmann Stiftung, Gütersloh (1993)
12. Gounko, T., Smale, W.: Modernization of Russian higher education: exploring paths of influence. J. Compar. Int. Educ. **37**(4), 533–548 (2007)

13. Hall, D.E.: Why professors should teach abroad. The Chronicle of Higher Education **54**(6): 20. Washington, D.C. (2007)
14. Held, D., McGrew, A., Goldblatt, D., Perraton, J.: Global Transformations: Politics, Economics and Culture. Polity Press, Cambridge (1999)
15. Janmaat, J.G.: Nation-Building, Democratization and Internationalization as Competing Priorities in Ukraine's Education System. Nation Papers, vol. 36, pp. 1–23 (2008)
16. Jayasuriya, K.: Learning by the market: regulatory regionalism, Bologna, and accountability communities. Glob. Soc. Educ. **1**, 7–22 (2010)
17. Kedia, B.L., Cornwell, T.B.: Mission based strategies for internationalizing U.S. business schools. J. Teach. Int. Bus. **5**(3), 11–29 (1994)
18. King, N.: The qualitative research interview. In: Cassell, C., Symon, G. (eds.) Qualitative methods in organizational research: a practical guide, pp. 14–36. Sage, London (1994)
19. King, K. (ed.): The politics of partnerships: Peril or promise, NORRAG NEWS, No. 41 Special Issue, (2008)
20. Knight, J.: The internationalisation of higher education: complexities and realities. In: Teferra, D., Knight, J. (eds.) Higher Education in Africa: The International Dimension, pp. 1–43. AAU/CIHE, Accra/Boston (2008)
21. Klymchuk, I.O.: World integration of higher education: challenges for Ukrainian universities. In: The 4th Multidisciplinary Academic Conference in Prague 2015, pp. 17–22 (2015)
22. Koehn, H., Rosenau, J.N.: Transnational Competence: Empowering Professional Curricula for Horizon-Rising Challenges Boulder. Paradigm, Colorado (2010)
23. Malan, T.: Implementing the bologna process in France. Eur. J. Educ. **39**(3), 289–297 (2004)
24. Marga, A.: Reform of Education in Romania in the 1990s: a retrospective. Higher Educ. Europe **XXVII**(1–2), 123–135 (2002)
25. Marginson, S.: Higher education in the global knowledge economy. Soc. Behav. Sci. **2**, 6962–6980 (2010)
26. Matthews, J., Sidhu, R.: Desperately seeking the global subject: international education, citizenship and cosmopolitanism. Glob. Soc. Educ. **3**(1), 49–66 (2005)
27. McArthur J.W., Sachs J.D.: A General Equilibrium Macroeconomic Model for Analysing African Rural Subsistence Economies and an African Green Revolution' academic working paper, Columbia University School of International and Public Affairs, (2009)
28. Neave, G.: Homogenization, integration, and convergence: the chershire cats of higher education analysis. In: Meek, L., Goedegebuure, L., Kivinen, O., Rinne, R. (eds.) The Mockers and the Mocked: Comparative Perspectives on Differentiation. Oxford, Pergamon, Convergence and Diversity in Higher Education (1996)
29. Olsen, J.P., Maassen, P.: European debates on the knowledge institution: the modernization of the university at the european level. In: Maassen, P., Olsen, J.P. (eds.) University Dynamics and European Integration, pp. 3–22. Springer, Dordrecht (2007)
30. Pechar, H., Pellert, A.: Austrian universities under pressure from Bologna. Eur. J. Educ. **39**(3), 317–330 (2004)
31. Spanier, G., Thomas, E.: Realising the Global University: Part One. The Observatory on Borderless Higher Education, London (2007)
32. Stake, R.E.: The Art of Case Study Research. Sage, Thousand Oaks, CA (1995)
33. Tauch, C.: Almost half-time in the Bologna-Process—where do we stand? Eur. J. Educ. **39**(3), 275–288 (2004)
34. Trondal, J.: The Europeanisation of research and higher educational policies: some reflection. Scandinavian Polit. Stud. **25**(4), 333–355 (2002)
35. van Vught, F.: Governmental Strategies and Innovation in Higher Education. Jessica Kingsley, London (1989)
36. van Vught F.: Policy Models and Policy Instruments in Higher Education. The Effects of Governmental Policy-Making on the Innovative Behaviour of Higher Education Institutions. Institut für Höhere Studien (HIS), Wien (1995)
37. Yin, R.K.: Case study research: Design and methods, 2nd edn. Sage, Newbury Park, CA (1994)

New Skills for Entrepreneurial Researchers

Mirjam Leloux, Florentin Popescu and Andries Koops

Abstract Knowledge exchange between universities and business in collaborative/contractual research and public-private partnerships has become far more significant. These developments instigate new mind-sets and skills for academic researchers, that should be able to translate their new technological concepts into new (business) developments. Using the two entrepreneurial functions—identification and exploitation— Park (Technovation 25: 739–752, 2005); Wright et al. (J. Technol. Transfer 29: 235–246, 2004) as well as the Vitae Researcher Development Framework (www.vitae.ac.uk) and Entrepreneurial competency framework (Int. J. Entrepreneur. Behav. Res. 6(2): 92–111, 2010), this chapter looks at the new, entrepreneurial skills that any academic researcher needs to make commercial exploitation of research a success. The purpose of this article is to investigate which (i.e. entrepreneurial) skills academic researchers need to facilitate to be more effective in exploiting their research. We especially focus on the academic researcher with a beta-scientific background.

Keywords Entrepreneurial skills · Academic researcher · Valorization · Exploitation of research

M. Leloux (✉)
Leloux Science & Business BV, Stationsweg 33, 6711 PJ Ede, The Netherlands
e-mail: mleloux@scienceandbusiness.nl

F. Popescu
HAN University of Applied Sciences, Ruitenberglaan 31, 6826 CC Arnhem, The Netherlands
e-mail: florentin.popescu@han.nl

F. Popescu
Bucharest University of Economic Studies, Piata Romana Nr. 6, Sector 1, Bucharest, Romania

A. Koops
Wageningen University and Research Centre, Droevendaalsesteeg 4, 6708 PB, Wageningen, The Netherlands
e-mail: andries.koops@wur.nl

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1 Introduction

Our knowledge economy is increasingly demanding that public universities, as new engines of regional innovation, exploit, transfer and commercialize their knowledge: the entrepreneurial university created [6]. Valorization activities of entrepreneurial universities include the following activities [48]: knowledge transfer, for example in consultancy or contract research, technology transfer, such as the out-licensing of patents, and transfer of products and services through spin-offs. In addition to the traditional role of universities to deliver high-quality professionals and excellent scientific knowledge, society requires greater attention to the transfer and commercialization of knowledge with the aim to encourage new business and regional development ([7, 11, 23, 41]). Due to these developments, the boundaries between academic research and entrepreneurship [50] fade. Traditionally, collaboration between universities and industry appeared to conflict with the independence of academic research [21]. Nowadays, however, such collaborations are increasingly enforced by national and international authorities.

In 2012, the Ministry of Economic Affairs in The Netherlands implemented the Top Sector Policy. Nine selected industries collaborate with universities and research centers to stimulate innovation in order to further strengthen its global position.

Therefore, one of the first steps towards competency-based education in the entrepreneurship field is the identification of relevant entrepreneurial competencies as they can predict business formation and success within and across cultures [25]. They sustain that the identification of relevant entrepreneurial competencies should provide insight into the field of entrepreneurship, and such competencies might predict business formation and success within and across cultures.

Scholars in the fields of entrepreneurship and innovation studies have long been interested in the entrepreneurial behavior of university researchers and universities' entrepreneurial activities more generally [4, 35, 39, 45]. However, very little is known about the acquisition skills (or entrepreneurial skills) academic researchers would need that are willing to "sell" or transfer their technology/intellectual property to companies. This is a crucial issue for both the entrepreneurship and the university-industry linkages literature in order to reach a better understanding of the entrepreneurial process.

The literature on academic entrepreneurship is focusing increasingly on opportunity identification and exploitation, recognizing them as being distinct and crucial for the study of entrepreneurship [34, 52]. These two entrepreneurial functions—identification and exploitation—differ in a number of important ways including the type knowledge transferred, the degree of complexity inherent in the activity and the risk associated with the activity.

2 Technology Transfer Offices

In universities, Technology Transfer offices (TTOs) were created to manage the growing number of connections between universities and industry. Technology transfer professionals supervise patenting processes, contact business for further development and application of scientific knowledge, or regulate the out-licensing or transfer of the patent. In addition, they seek contact with potential investors for further development of spin-offs, which the researcher as (independent) entrepreneur can start to operate. TTOs can be very effective if they have a clear strategy to add value within the university. The university board should set transparent policy objectives and priorities, coupled to adequate resources, make a clear choice as to the type of technology transfer (contract research, licensing, spin-offs, etc.), be aware to setting incentives for scientists (for example, by giving them a share of revenues associated with the exploitation of their research), and enable the implementation of a clear process for technology transfer (procedures, activities, organization, training for bilingual professionals; [35]. Between TTOs much difference in effectiveness occurs [49], potentially linked to their different phases of development [13]. In the Netherlands, TTOs are currently orientating to further professionalization.

TTO professionals also have a role in further encouraging academic researchers to valorize the results of their research [13, 20]. Valorization can increase their recognition in the scientific community and also creates opportunities to generate their own funding to further invest in their research [44]. Some researchers get extra motivation from applying their results in business or policy changes in government.

3 Skills for Academic Scientific Researcher

Throughout their careers from Ph.D., postdoc to assistant professor, associate professor or full professor, academic researchers develop different competencies. In British universities, the professional development of the competencies of academic researchers regularly use the Vitae Researcher Development Framework (www.vitae.ac.uk), see Fig. 1.

This involves the development of competence in the field of Knowledge and intellectual abilities (domain A), Personal effectiveness (domain B), Engagement, influence and impact (domain C) and Research governance and organization (domain D).

During their Ph.D. phase academic researchers learn to do independent research and publishing in ‘refereed journals their results. In this phase, researchers are almost entirely focused on their intellectual development, scientific track record (Domain A) and personal effectiveness (Domain B). In the meantime, the postdoc phase

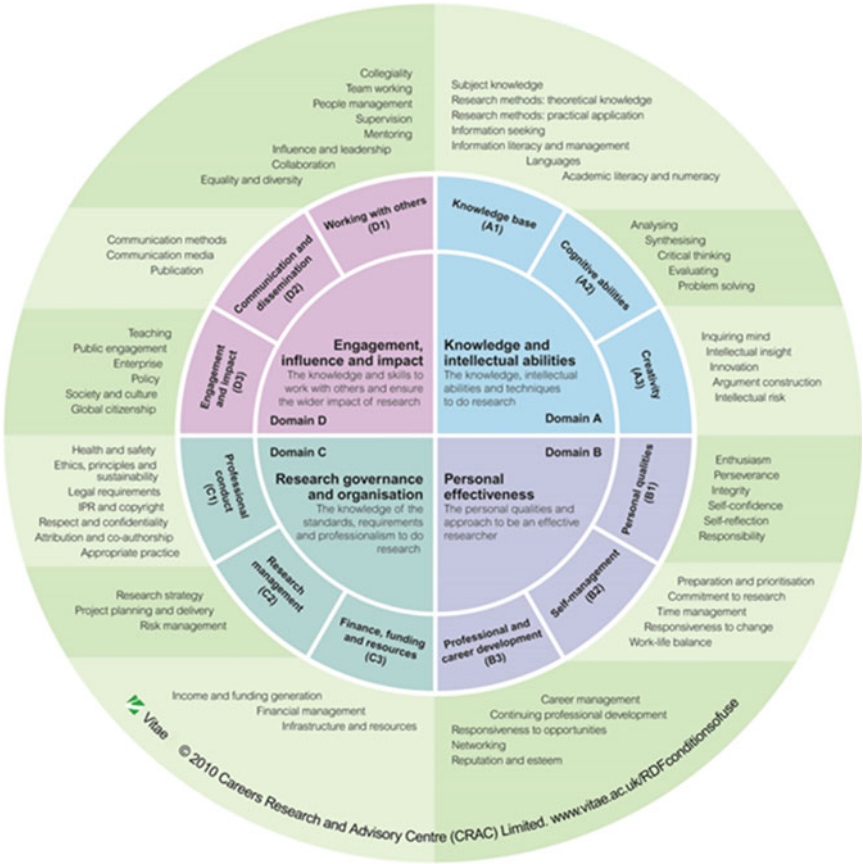


Fig. 1 Competencies of academic researchers. *Source* Courtesy of 'Vitae Researcher Development Statement', © 2010 Careers Research and Advisory Centre (CRAC) Limited, www.vitae.ac.uk/rdf

postdoctoral researchers are trained to submit research proposals themselves in order to get funding, and to further establish and build their scientific position. Besides scientific skills, personal effectiveness, strategic insight, international networking and communicating skills with various parties (including businesses) becomes increasingly important (domains B and D). In their further development to a full professorship, management skills are becoming increasingly important (domain C).

The current emphasis on funding applications in collaboration with private parties, such as national grants or EU-projects, more skills in communication and collaboration (domain D) are demanded. Researchers can be especially successful if they are able to mobilize companies to support. Such cross-disciplinary communication requires a lot of listening skills, agility and empathy therefore more entrepreneurial skills should be developed as well.

4 Academic Entrepreneurship

A vast amount of literature exist on entrepreneurship skills. According to Mitchelmore and Rowley [28] there are four key areas that need to be developed to have success as an entrepreneur (1) entrepreneurship; (2) business and management; (3) human relations; (4) conceptual and relational competencies (refer to Table 1).

Table 1 Entrepreneurial competency framework (after [28])

Entrepreneurship		
Identification and definition of a viable market niche	*Development of products or services appropriate to the firms chosen*	*Market niche/product innovation*
Idea generation	Environmental scanning	Recognizing and envisioning taking advantage of opportunities
Formulating strategies for taking advantage of opportunities		
Business and Management		
Development of the management system necessary for the long term	Functioning of the organization	Acquisition and development of resources required to operate the firm
Business operational skills	*Previous involvement with start-ups*	Managerial experience, skills and style
Familiarity with industry and market	Financial and budgeting skills	Goal setting skills
Business plan preparation	*Marketing skills*	Technical skills
Industry skills	*The ability to implement strategy (develop programs, budgets, procedures, evaluate performance)*	
Human Relations		
Development of the organizational culture management feels is necessary to guide the firm	Delegation skills	The ability to motivate others individually and in groups
Hiring skills	*Human relations skills*	Leadership skills
Conceptual and relationship competencies		
Conceptual competencies	Organizational skills	*Interpersonal skills*
The ability to manage customers	Mental ability to coordinate activities	Written communication skills
Oral communication skills	Decision-making skills	Analytical skills
Logical thinking skills	*Deal-making skills*	*Commitment competencies*

Dickson [5] and Jain et al. [17] distinguish different types of academic entrepreneurs: the academic scientist purely interested in fundamental research, the hybrid professional with both scientific and commercial qualifications, and the academic entrepreneur in charge of marketing of knowledge-intensive products. This latter type: the academic entrepreneur, who detaches from university through a spin-off, has besides scientific competences also managerial and advisory skills, business skills and knowledge in a number of "other" knowledge areas such as law and business administration [22]. The academic entrepreneur should have the ability to discover novel opportunities, acquire the funds to have this novel opportunity to develop into a profitable activity, and persuade others to participate [36, 37]. Such "academic entrepreneurship" however relates the least with the natural tasks and interests of an academic researcher [24] and it is therefore less common.

Table 1 presents an overview of "entrepreneurial competences". If we compare these with the competencies of the academic researcher (Fig. 1), we can identify which entrepreneurial competencies may be new to scientific researchers, but probably recommended or necessary for those who are more involved in further commercial exploitation of research. Some (strategic) entrepreneurial skills may be "known" skills for academic researcher, but are applied by them in a different context. For example, defining a niche (Table 1, entrepreneurship) is important not only for the business professional but may also be vital to the success of an academic researcher. The niche that gives him passage to success and competitive advantage to other researchers is not only determined by the quality of his/her research, but also by the choices that follow from a proper environmental analysis: the scientific and social relevance of the research themes, the application of new technologies and development of innovative approaches resulting in a new breakthrough, and identifying and developing smart and sustainable partnerships. The best partnerships provide inspiration, and innovation occurs, especially at the interface of different fields of knowledge. The researcher who wants to focus more on valorisation would precisely develop such collaborations at the university/business interface to identify novel exploitation and funding avenues. He/ she must not only develop international scientific networks, but also business-oriented networks.

A number of "entrepreneurial competencies" are similar to "academic competencies", but the context is different. Interpersonal skills (Table 1, human relation skills) needed to benefit from the added value of working with a (private) partners are the same as those of the entrepreneur: listening, empathy and conceptual agility. For successful collaborations with businesses, however, scientists need to be less inside-out thinking (supply-oriented) and more outside-in (demand-driven), so they better understand the challenges of the business community to develop innovative solutions. Empathy with the 'client', to be able to provide solutions in the company's interests without losing the interest of their own knowledge organization, free knowledge and scientific quality are crucial. That requires an attitude of giving and taking, the ability to represent the own research interests of research and at the same time keeping its own quality, without compromising. Learning to listen to a client: this represents for many scientists an important new skill.

Successful researchers use different funds to finance research, such as EU framework project in the recently launched Horizon 2020 program. These are, by definition, sector and cross-disciplinary projects with multiple partners. This requires project management skills, results-orientation, dealing with other cultures (Table 1, relationship management and competences). All skills that the entrepreneur needs too.

In summary: the main differences between Fig. 1 and Table 1 (indicated in italics in Table 1) are in the entrepreneurial managerial competencies (knowledge of business, marketing knowledge), and the broader arsenal of communication and interpersonal relational skills and commercial competencies (skills acquisition, deal-making).

5 Development of Entrepreneurship Skills

The literature on university-industry technology transfer defines an academic entrepreneur as a university scientist who engages in the commercialization of the results of his/her research, largely by patenting and/or setting up a business. Licensing to non-academic inventors is a frequent path to commercialization when patents are an effective mechanism for appropriating the returns to innovation [42].

The literature on academic entrepreneurship research is rather vague about the factors that contribute to the development of entrepreneurial skills among academic scientists—particularly the skills required to build technological opportunity sources and enable their exploitation. The literature suggests that prior knowledge of markets and customers' problems positively contributes to the development by academic researchers of new discoveries and technological breakthroughs and leads to potential commercial opportunities [41].

Current trainings for academic scientists in the field of valuation and/or entrepreneurship is limited. In the Netherlands, there is a masterclass BioBusiness for developing new businesses in the life science (www.masterclassbiobusiness.nl), and some public-private partnerships (www.tipharma.com) or universities provide courses about valorization, especially oriented towards patenting issues, targeted at Ph.D. students. The EC Liaison Office of Economic Affairs in the Netherlands also presents workshops for academic researchers to focus on new collaborations within Horizon 2020 EU guidelines (www.rvo.nl) projects. However, similar courses targeted at the broad group of more experienced academic researchers interested in exploitation of research and development of skills associated with these (interpersonal relational competencies, acquisition skills) are scarce.

For a society interested to train academic researchers in the field of entrepreneurial skills, it would be wise, according Grimaldia et al. to invest at three levels: system (government) institution and individual level.

6 System Level

From 2003, in most countries of the European Union the importance of entrepreneurship education has been stressed in general [9, 16], e.g. for economic reasons, creating job growth [51], but also because of the positive effect on the involvement and motivation of students [46]. In the domain of entrepreneurial education an often advocated approach to assess the degree of competencies developed in an entrepreneurship course or program is the use of pseudo-randomized experiments with pre- and post-measurements on treatment and control groups [26]. The measurement instruments are often survey-based and try to capture the prevalence of entrepreneurial knowledge, skills, attitudes and intentions before and after an educational treatment.

How entrepreneurial education is carried out in practice varies substantially, primarily depending on which definition is used [30], but also depending on what underlying educational paradigm is applied [1]. Common activities, often termed "outreach", include assisting local entrepreneurs, interacting with student clubs, inviting alumni and experts, visiting networking events, conducting student consulting and participating in business plan competitions [8, 30, 38]. Less common activities include interaction with incubators and technology transfer offices for university commercialization purposes [29, 31]. Hynes and Richardson [15] outline several benefits of outreach arrangements for students, faculty, researchers and stakeholders outside university.

Enterprises in Europe believe that the EU can potentially play an important role in promoting competence development in enterprises and in ensuring better quality trainers [9]. The European Union will not resume growth driven by higher productivity and innovation without highly skilled workers who can contribute to innovation and entrepreneurship [9]. Companies do not only need new skills, the right competences and innovative thinking; where appropriate, the existing workforce must constantly update their knowledge, skills and competences to meet new demands and future changes. Training at the workplace plays an important role and is increasingly recognized as an efficient way to equip people with transversal and job-specific skills. It also contributes to the European 2020 headline target stipulating that, by 2020, 15 % of the population aged 25 to 64 should participate in lifelong learning.

7 Institute Level

Many outreach activities are extra-curricular due to difficulties in integrating them into formal courses and programs [3]. A notable exception to this is a "venture creation approach" [32], i.e. when entrepreneurial education is formally integrated with commercialization entities at the university. This constitutes an exception from the prevailing norm that the formation of spinoffs based on university research is

managed by technology transfer offices or similar entities, without integration to entrepreneurial education [43]. Some programs applying a venture creation approach have shown interesting outputs in terms of both student learning and student-led venture creation [2, 14, 27, 47].

In several Dutch universities, training in the field of entrepreneurship is presented as part of bachelor or master educational programs. Entrepreneurship education can be given from different perspectives [12, 18, 33, 40]: (1) the transfer of technical knowledge about business, management and organization; (2) the acquisition of skills and competencies, and (3) the experiential approach using case studies, where students go through a real entrepreneurial learning [19]. However, to our knowledge no such entrepreneurship courses exist dedicated to the professional academic researcher.

Within universities new strategies to link teaching, research and commercialization, or internal mechanisms and approaches can be developed to encourage academic scientists to use the challenges of the new era of research exploitation: setting up network meetings for scientists with private parties (e.g. through alumni network), creating more "awareness" in valorization, showcase successes, business coaching or even creation of special educational entrepreneurship programs for advanced academic researcher. Such entrepreneurial programs would especially have to focus on learning skills and experiential learning. For researchers who aspire to be involved in a spin-off, business plan competitions, boot camps, setting up an incubator fund and new employee rules (such as a fallback option to their previous job) should be developed. A paradigm shift in human resources management at universities should be needed to: currently universities measure the success of a scientist on scientific track record, H-factor and international status. In this coming new era, however, successes in exploitation and development of entrepreneurial competencies should count too.

On one side entrepreneurial competency development is promoted by national and international policymakers, on the other side the trend towards more neoliberal educational systems are increasingly excluding this very kind of competency development. This paradox is evident in the Swedish school system today [10], and perhaps in many other education systems too.

8 Individual Level

Traditionally, the academic researcher is mainly driven by two aspirations: curiosity and personal recognition. He/she will only be interested to invest in the development of personal entrepreneurial competencies if the academic surroundings will provide support and recognition. Some basic knowledge of business/marketing, improved networking with private parties, or better communication skills should make, either through an increase of funding or by additional contract research with industry, or revenue by licensing out patents should make more fundraising possible. Experiential and interactive training in skills acquisition (how to make new

contacts, negotiation, management of expectations, interview techniques, nonverbal communication) may be needed for this. An experiential training model, involving business coaching (assisting researchers on their acquisition path by experienced business development managers) and role play in which examples, pitfalls and failures are re-enacted in practice should be offered in a personalized tailor-made approach. After all, there are large differences among researchers in their personality development process, skills, role, or ambition. Mutual trust and respect between trainer, researcher and potentially also his/her manager is essential. This may also imply that the role of the leader of the research group (group head, professor) will be changing. Not only track record is only leading to qualify the output of an academic scientist, but also the extent to which research results in new business, new products or addresses social problems. This may require investment a deliberate investment of quality time in making individualized plans, coaching and monitoring.

The time is already behind us that knowledge institutions are driven by personal academic curiosity only. Society, governments, and new business stakeholders are increasingly asking universities to translate their innovative potential into products and services that impact society. This will require different and new entrepreneurial skills of researchers. That is why new academic trainers can facilitate traineeships and exchanges, sharing experiences and other learning activities, enhancing entrepreneurial attitudes and skills (e.g. engaging young people in direct entrepreneurial experiences, on the job training, networks, promotion of specialized skills) and support efforts to define the learning outcomes of such activities. Also it can promote the development of tools to allow young people to assess and present their entrepreneurial skills and competences.

References

1. Ardalan, K.: The philosophical foundation of the lecture-versus-case controversy: its implications for course goals, objectives, and contents. Int. J. Soc. Econ. **35**, 15–34 (2008)
2. Barr, S.H., Baker, T., Markham, S.K.: Bridging the valley of death: lessons learned from 14 years of commercialization of technology education. Acad. Manag. Learn. Educ. **8**, 370–388 (2009)
3. Botham, R., Mason, C.: Good practice in enterprise development in UK higher education. In: NCGE (ed.) Research Report (2007)
4. Chrisman, J.J., Hynes, T., Fraser, S.: Faculty entrepreneurship and economic development: the case of the university of Calgary. J. Bus. Ventur. **10**(4), 267–281 (1995)
5. Dickson, K., Coles, A., Smith, H.: Science in the market place: the role of the scientific entrepreneur. In: During, W., Oakey, R. (eds.) New Technology-based Firms in the 1990s, pp. 27–37. Paul Chapman, London (1998)
6. Etzkovitz, H.: Research groups as "quasi firms": the invention of the entrepreneurial university. Res. Policy **32**(1), 109–121 (2003)
7. Etzkovitz, H.: Anatomy of the entrepreneurial university. Soc. Sci. Inf. **52**(3), 486–511 (2013)
8. European Commission: Survey of Entrepreneurship in Higher Education in Europe. Brussels: DG Enterprise and Industry (2008)

9. European Commission: Entrepreneurship Education at School in Europe - National Strategies, Curricula and Learning Outcomes (2012)
10. Falk-Lundqvist, Å., Hallberg, P.-G., Leffler, E., Svedberg, G.: Entrepreneurial pedagogy in schools: driving forces for pupils' learning. Liber, Stockholm (2011)
11. Grimaldia, R., Kenney, M., Siegel, D.M., Wright, M.: 30 years after Bayh–Dole: reassessing academic entrepreneurship. Res. Policy **40**, 1045–1057 (2011)
12. Heinonen, J., Hytti, U.: Back to basics: the role of teaching in developing the entrepreneurial university. Int. J. Entrepreneur. Innov. **11**, 283–292 (2010)
13. Hockaday, T.: Phases of Growth in University Technology Transfer, Les Nouvelles, pp. 275–279 (2013)
14. Hofer, A.-R., Potter, J., Fayolle, A., Gulbrandsen, M., Hannon, P., Harding, R., Dahlstrand, Å. L., Phan, P.H.: from strategy to practice in university entrepreneurship support: strengthening entrepreneurship and local economic development in eastern germany: youth, entrepreneurship and innovation. In: OECD (ed.) OECD Local Economic and Employment Development (LEED) (2010)
15. Hynes, B., Richardson, I.: Entrepreneurship education—a mechanism for engaging and exchanging with the small business sector. Educ. Training **49**, 732–744 (2007)
16. Hytti, U., O'gorman, C.: What is "enterprise education"? An analysis of the objectives and methods of enterprise education programmes in four European countries. Educ. Training, vol. 46, pp. 11–23 (2004)
17. Jain, S., George, G., Maltarich, M.: Academics or entrepreneurs? Investigating role identity modification of university scientists involved in commercialization activity. Res. Policy **38**(6), 922–935 (2009)
18. Johnson, C.: Enterprise education and training. British J. Educ. Work **2**, 61–65 (1988)
19. Kyrö, P.: Entrepreneurial learning in a cross-cultural context challenges previous learning paradigms. In: Kyrö, P., Carrier, C. (eds.) The Dynamics of Learning Entrepreneurship in a Cross-Cultural University Context, University of Tampere, Research Centre for Vocational and Professional Education, Entrepreneurship Education Series, vol. 2, pp. 68–102 (2005)
20. Lam, A.: From ivory tower traditionalists to entrepreneurial scientists? academic scientists in fuzzy university—industry boundaries. Soc. Stud. Sci. **40**(2), 307–340 (2010)
21. Lee, Y.S.: Technology transfer and the research university: a search for the boundaries of university-industry collaboration. Res. Policy **25**(6), 843–863 (1996)
22. Lockett, A., Wright, M., Franklin, S.: Technology transfer and universities spin-out strategies. Small Bus. Econ. **20**(2), 185–200 (2003)
23. Lopez, A.S.: Towards a model of entrepreneurial universities: significance, theory and research implications. Rev. Manage. Innov. Creat. **6**(18), 1–15 (2013)
24. Lundqvist, M.A., Williams Middleton, K.L.: Academic entrepreneurship revisited—university scientists and venture creation. J. Small Bus. Enterp. Develop. **20**(3), 603–617 (2013)
25. Mansfield, R.S., McClelland, D.C., Spencer, L.M., Santiago, J.: The identification and assessment of competencies and other personal characteristics of entrepreneurs in developing countries, Final Report: Project No. 936–5314, Entrepreneurship and Small Enterprise Development, Contract No. DAN-5314-C-00-3065-00. Washington, DC: United States Agency for International Development (1987)
26. Martin, B.C., Mcnally, J.J., Kay, M.J.: Examining the formation of human capital in entrepreneurship: a meta-analysis of entrepreneurship education outcomes. J. Bus. Ventur. (2012)
27. Meyer, A.D., Aten, K., Krause, A.J., Metzger, M.L.: Creating a university technology commercialisation programme: confronting conflicts between learning, discovery and commercialisation goals. Int. J. Entrepreneur. Innov. Manage. **13** (2011)
28. Mitchelmore, S., Rowley, J.: Entrepreneurial competencies: a literature review and development agenda. Int. J. Entrepreneur. Behav. Res. **6**(2), 92–111 (2010)

29. Moroz, P.W., Hindle, K., Anderson, R.: Collaboration with entrepreneurship education programmes: building spinout capacity at universities. Int. J. Innov. Learn. **7**, 245–273 (2010)
30. Mwasalwiba, E.S.: Entrepreneurship education: a review of its objectives, teaching methods, and impact indicators. Educ. Train. **52**, 20–47 (2010)
31. Nelson, A., Byers, T.: Challenges in university technology transfer and the promising role of entrepreneurship education. Working paper (SSRN ID 1651224). Emerging Scholars Initiatives. Kauffman (2010)
32. Ollila, S., Williams-Middleton, K.: The venture creation approach: integrating entrepreneurial education and incubation at the university. Int. J. Entrepreneur. Innov. Manage. (2011)
33. O'Connor, A.: A conceptual framework for entrepreneurship education policy: meeting government and economic purposes. J. Bus. Ventur. **8**(4), 546–563 (2012)
34. Park, J.S.: Opportunity recognition and product innovation in entrepreneurial hi-tech start-ups: a new perspective and supporting case study. Technovation **25**, 739–752 (2005)
35. Phan, P.H., Siegel, D.S.: The effectiveness of university technology transfer. Found. Trends Entrepreneur. **2**(2), 77–144 (2006)
36. Rasmussen, E., Mosey, S., Wright, M.: The evolution of entrepreneurial competencies: a longitudinal study of university spin-off venture emergence. J. Manage. Stud. **48**, 1314–1345 (2011)
37. Rasmussen, E., Mosey, S., Wright, M.: The influence of university departments on the evolution of entrepreneurial competencies in spin-off ventures. Res. Policy **43**(1), 92–106 (2014)
38. Rice, M.P., Fetters, M.L., Greene, P.G.: University-based entrepreneurship ecosystems: key success factors and recommendations. In: Fetters, M.L., Greene, P.G., Rice, M.P., Butler, J.S. (eds.) The Development of University-Based Entrepreneurship Ecosystems: Global Practices. Edward Elgar, Cheltenham, UK (2010)
39. Rothaermel, F.T., Agung, S.D., Jiang, L.: University entrepreneurship: a taxonomy of the literature. Ind. Corpor. Change **16**(4), 691–791 (2007)
40. Scott, M.G., Rosa, P., Klandt, H.: Educating Entrepreneurs for Wealth Creation, Aldershot Ashgate (1998)
41. Shane, S.: Prior knowledge and discovery of entrepreneurial opportunities. Org. Sci. **11**, 448–469 (2000)
42. Shane, S.: Selling university technology: patterns from MIT. Manage. Sci. **48**(1), 122–137 (2002)
43. Shane, S.A.: Academic Entrepreneurship: University Spinoffs and Wealth Creation. Edward Elgar Publishing (2004)
44. Siegel, D., Waldman, D., Link, A.: Assessing the impact of organizational practices on the relative productivity of university technology transfer offices: an exploratory study. Res. Policy **32**, 27–48 (2003)
45. Stuart, T.E., Ding, W.W.: When do scientists become entrepreneurs? The social structural antecedents of commercial activity in the academic life sciences. Am. J. Soc. **112**(1), 97–144 (2006)
46. Surlemont, B.: Promoting enterprising: a strategic move to get schools' cooperation in the promotion of entrepreneurship, In: Fayolle, A. (ed.) Handbook of Research in Entrepreneurship Education: Contextual Perspectives. Cheltenham, UK (2007)
47. Thursby, M.C., Fuller, A.W., Thursby, J.: An integrated approach to educating professionals for careers in innovation. Acad. Manage. Learn. Educ. **8**, 389–405 (2009)
48. Tijssen, R.J.W.: Universities and industrially relevant science: toward measurement models and indicators of entrepreneurial orientation. Res. Policy **35**(10), 1569–1585 (2006)
49. Tseng, A.A., Raudensky, M.: Performance evaluations of technology transfer offices of major US research universities. J. Technol. Manage. Innov. **9**(1), 93–102 (2014)

50. Vallas, S.P., Kleinman, D.L.: Contradiction, convergence and the knowledge economy: the confluence of academic and commercial biotechnology. Socio-Econ. Rev. **6**(2), 283–311 (2008)
51. Wong, P.K., Ho, Y.P., Autio, E.: Entrepreneurship, innovation and economic growth: evidence from GEM data. Small Bus. Econ. **24**, 335–350 (2005)
52. Wright, M., Birley, S., Mosey, S.: Entrepreneurship and university technology transfer. J. Technol. Transfer **29**, 235–246 (2004)

Female Captains and Their Leadership: Human Factors in the Shipping Industry

Momoko Kitada

Abstract Seafaring has been traditionally seen as a male-dominated occupation where women's participation is extremely low in many parts of the world. In particular, Captains on merchant ships are often found to be men who tend to project a certain authoritative figure in the context of a ship hierarchy. Nevertheless, the representation of women in seafaring jobs has been recently more accepted though still a few. This paper discusses how the notion of leadership on board a ship can be challenged by female Captains and how they have learned leadership and applied in ship operations. Gender issues are an important part of human factors, impacting on crew's relationship and teamwork under the leadership of a Captain. In this research, seven female and three male Captains were individually interviewed. An inquiry to female Captains and leadership will provide a new source of data for re-thinking human factors in the shipping industry.

Keywords Women leadership · Human factor · Shipping industry · Seafarers · Gender

1 Introduction

Captains on merchant ships have been often described as male figures, assuming that seafaring is a male occupation. Indeed, the representation of women in seafaring jobs is extremely low in many parts of the world. Only 1 or 2 % of the total seafaring population is considered to be women [1]. When it comes to officers in senior ranks, such as Captains and Chief Engineers, the number would be even less. Nevertheless, the participation of women in seafaring jobs has been recently more accepted and some shipping companies are rather positive to promote women to be Captains under their corporate social responsibility (CSR) policy. There are also pioneers of female Captains in the 80s and 90s who may be treated as heroines in

M. Kitada (✉)
World Maritime University (WMU), Malmö, Sweden
e-mail: mk@wmu.se

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public. To understand the implication of having more female leaders in the shipping industry, this paper discusses how the notion of leadership on board a ship can be challenged by female Captains and how they have learned leadership and applied in ship operations.

From a perspective of human factors, gender issues are understood as an influencial factor to human resource management. The working culture on board ships reflects masculine norms and values which all crew members adopt and share [2]. Although simply having a woman on board would not significantly change the culture, the research shows that the participation of women seafarers tend to show an impact on male seafarers' behaviour and attitudes on board and they often modify their rough manners in a more civilised way [3]. It is therefore important to consider gender relations as human factors influencing crew's relationship and teamwork, in particular, when having a female Captain as an ultimate leader on board.

2 Barriers to Women Seafarers' Career Development

As seafaring is one of the extreme examples of male-dominated professions, gender-related barriers to their career development have been reported elsewhere. The study on women seafarers initiated by the International Labour Organization (ILO) in 2003 highlights gender discrimination and sexual harassment that some women experienced on board ships in relation to their male colleagues [4]. More recently, a survey on women seafarers' health issues revealed that 17 % of women experienced sexual harassment on board [5].

Gender discrimination is also likely to occur when female cadets try to access to ships for work or on-board training. Some shipowners and manning agencies are unofficially excluding women from employment as officers or trainees to work on their vessels [6]. Another barrier which prevents women seafarers from their sea career development may be the issue of marriage and family [7]. Although not all women are going to marry or have children, it has a considerable amount of pressure for women seafarers and most of them quit their seafaring jobs before reaching senior leadership positions on board. In addition, the research suggests that female maritime officers tend to underestimate their own leadership skills and that 'women are better leaders than they think' [8].

These gender-related problems are indeed obstacles for the industry from the human factors perspective. As a result, the number of women seafarers has not increased much despite the global efforts made by the International stakeholders, including the International Maritime Organization (IMO), the ILO, and the International Transport Workers' Federation (ITF). Even before women climb up to leadership positions, only a few can remain successfully as seafarers.

3 From a Subordinate to a Superior: Developing Leadership Through Experience

A discourse whether leaders are born or made represents a classic concern of people in various aspects of their social relations [9]. Regardless their wishes and intentions, in reality, anyone who work in business worlds could be given an opportunity to perform as a leader by promotions.

Seafaring is an occupation which has an extremely hierarchical structure, from a Captain as an absolute authority to ratings as a bottom. Each rank of a ship echelon is strictly defined as first, second, and third officer, for example. No one becomes a Captain or first officer unless they have been worked as subordinate positions like second and third officer levels. It is an unexceptional progression of officers' career and their experience and knowledge are highly counted by reaching each rank. This kind of senior-junior relationship mirrors a traditional leadership research assumption that leadership is bestowed upon followers who are recipients of that bestowal [10].

If a leadership is something to be acquired from the time as a subordinate to the moment that they reach a superior position, and perhaps they continue to train their leadership by being a Captain, one may ponder whether the process of seafarers' career progression could influence their leadership. It is particularly interesting to look into women's experience that they have been survived in a male-dominated work environment of ships and reached the highest position of a Captain.

The literature on leadership also highlight this claim that 'the primary source of learning to lead, to the extent that leadership can be learned, is experience. The role played by training and other formal programs is relatively modest in comparison to other kinds of (on-the-job) experiences' [11]. This view matches the process of vocational education and training, such as seafaring. Leadership skills are acquired in the process of learning, and onboard experiences provide an extensive source of learning for leadership. Cognitive theories of learning also emphasises the importance of experience which relates to the development of knowledge structures [12]. In the healthcare sector, a professional identity shapes practice and provides a source of energy to perform work [13]. Daire and Gilson report in their research that some nurses demonstrated an emerging leadership identity, making a transition from nurse to leader, and thus developing leadership competencies [14].

In another study, DeRue and Wellman examined how individuals develop leadership skills via on-the-job experiences by contacting 99 middle- and senior-level managers over 80 different for-profit and not-for-profit organisations. They found that the relationship between developmental challenge and leadership skill development exhibits a predominantly positive, concave downward curve, whilst the developmental value of those experiences begins to decrease when work experiences reach high levels of developmental challenge [15]. It indicates that one's experience could shape their leadership, and 'gendered' experience may possibly influence female Captains' leadership on board ships.

4 Methods

4.1 Leadership Positions in Seafaring Jobs

Leadership positions on merchant ships are generally considered to be senior ranks, such as Captains, Chief officer/First officers, Chief Engineers and First engineers. These senior ranking officers have different roles on board even though they are all leaders of the teams. Different roles and responsibilities among senior officers basically count on their experiences and knowledge level over the years of working at sea. In order to measure the same level of leadership, this research considers Captain's level on merchant ships for investigating gender and leadership.

This study is particularly interested in how the notion of leadership on board a ship can be challenged by female Captains and how they have learned leadership and applied in ship operations. In order to answer these questions, the paper considers how women's work experience in a male-dominated workplace would possibly shape their leadership through their career progression. Although it does not aim at merely comparing women with men in terms of Captains' leadership, the researcher believes that it is important to listen to male Captains and their views on leadership in order to holistically understand the idea of leadership as a Captain. As feminist standpoints theorists claim that men's visions are only 'partial' [16], this research intends to de-construct such research practices by listening to both men and women.

4.2 Qualitative In-depth Interviews

To understand Captains' leadership roles and experiences, qualitative research methods were chosen as Denzin and Lincoln explains that qualitative methods emphasises the exploration of meanings and experience as well as engagement in the process [17]. This research primarily employed in-depth interviews except for one case with a Portuguese female Captain who was eager to participate in the research however e-mail interview was the only possible way for her to take part in. Other research methods, such as observation and focus group, are not suitable in terms of access to the respondents. Observing the work of a Captain on his/her vessel was not practically possible in terms of ethics as well as safety and security reasons. Focus groups were also difficult to set up as their work schedules are often different.

4.3 Data Collection and Analysis

In the recruitment process of both female and male Captains, contact persons in each country were found through the networks of the Seafarers International Research Centre (SIRC), UK as well as the World Maritime University (WMU),

Table 1 The list of interviewees

Gender	Nationality	Age	Type of vessels
Female 1	Portuguese	41	Container; Bulk; Reefer
Female 2	Portuguese	51	Bulk; Tanker
Female 3	Swedish	39	Bulk; Tanker; Ferry; Ro-Ro
Female 4	German	43	Tanker; Reefer; Container
Female 5	Ghanaian	52	Bulk; General
Female 6	Indian	29	Tanker
Female 7	Fijian	39	Container
Male 1	Portuguese	57	General
Male 2	German	44	Container; General; Reefer; Bulk
Male 3	Indian	59	Container; Bulk; Chemical; Oil

Sweden. The list of interviewed Captains is shown in the Table 1. Seven female and three male Captains from six different countries (Portugal, Sweden, Germany, Ghana, India and Fiji) were interviewed between 2007 and 2014. Although the nationalities of participants were diverse, a sample from one country cannot represent their national culture and one country can contain many cultures. Hence, this research does not look into each nationality as differences, but rather the same occupational group of people who share the same values and norms in their jobs and leadership. Except for an Indian female Captain whose age was 29, the majority of female and male Captains were between 39 and 59 years old. The types of vessels which they commanded were container ships, tanker ships (including oil or chemical tankers), bulk carriers, general cargo ships, reefer ships, ferries, Ro-Ro ships, and car carriers.

Prior to the interviews, the consent was obtained from the participants. The researcher focused on her role as a listener and let the participants speak about their experiences and views as a Captain. The researcher's seafaring experience was helpful to establish a good rapport as well as understanding the contexts. Being an insider can be a bias in research, however my seafarer license was not as high as Captains' and they seemed to be confortable with speaking someone junior to them. Interviews normally took approximately 1 h in both public and private locations, such as restaurant, cafe, office room, homes of the participants who kindly invited me to visit them.

The interview data were audio-recorded upon permission. They were transcribed by the researcher, and then colour-coded and analysed by the qualitative research software, called Nvivo.

5 Results

The narratives that both female and male Captains made were analysed and three key issues emerged as presented in the following sub-headings.

5.1 A Captain Can Be a Woman

The study shows no particular hindrance for women seafarers to perform as a Captain on a merchant vessel. Both German male and female Captains noted a positive effect of having a woman on board a ship which tended to become happier in its atmosphere. Seafarers' behaviour and language also became polite with a presence of a woman on broad. These additional values which female Captains bring to a traditionally male-dominated work environment were generally acknowledged.

No male Captains expressed a view that women might feel difficulties in his roles and responsibilities when women take his position. Unlike junior officers who are usually expected to hold a certain degree of 'toughness' to be a competent seafarer, the Captain's level seems to require less masculine tone of competence. An Indian male Captain made a very brief description of a Captain's role as 'making sure everything is ok'. This short summary of a Captain's role is however hitting the right nail on the head. If everything is working all right, his/her subordinates in different ranks continue their work; Only when something went wrong, the Captain will be called and guide the crew to fix the problem.

This understanding of a Captain's roles and responsibilities matches with the author's previous research finding that women seafarers tend to feel free from the pressure of behaving like a man when they reach a higher position, which also protects them and guarantees their competencies as senior officers [18]. It can be suggested that a Captain is an ideal position for women in terms of a lesser degree of gender-related problems in the male-dominated workplace like ships.

5.2 Work Experience Affects Leadership

Some female Captains noted that their experience of working with male followers are not always straightforward. A Fijian female Captain mentioned that she always needed to prove her competencies by hard-working as many women seafarers experienced the same while at sea. As a consequence, her difficult experience as a woman seafarer through the seafaring career helped to develop her confidence as a Captain:

> We have to work as twice as men to prove that we can do a job. (…) I was practising my confidence. I was so shy. I talked so low. (…) Now I develop so much confidence through my work experience, particularly by sailing (Female Captain 7).

The influence of on-the-job experience on leadership skills was also described by another female Captain from Portugal who says:

> I was brought from merchant marine and the knowledge, it was very responsible for my career. (…) For a woman, I can advise two things. Not permit to be treated like something fragile, because when they do that, the woman doesn't work but they speak badly. The other side, behave sexually…in a convenient way. (…) You know this is the reality to take care of their positions and their attitudes (Female Captain 1).

This Portuguese female Captain explained that she had learned how to behave wisely as a woman to balance her gender identities. It was problematic to be seen as a stereo-typical weak woman. On the other hand, her gender identity as a woman sometimes worked well to act as a lubricant when looking after her male crew. This kind of game play can be understood as a unique characteristic of female Captains who need to handle the issues on board and apply their feminine qualities in their leadership and management at sea.

5.3 Shaping a Leadership Identity

Since one's work experience forms the idea of leadership, many seafarers are more exposed to male Captains as leaders on board the vessels and some may reject a female representation as a leader. In many occasions, the crew who have never worked with a female Captain before tend to be non-receptive towards female leadership in the beginning. Consequently, if seafarers used to deal with male Captains through their work experiences, some may challenge a female Captain's leadership which is not predictable for them. This kind of event contradicts to the first point that shipboard leadership is not gender-biased. Even though a ship hierarchy defines that, whoever the Captain is, she or he is a ruler, it is equally a learning process for male subordinates to work under their female Captain.

Some female Captains explained how they negotiated their leadership identity in order to fit for purpose. For example, a Swedish female Captain worked with a male subordinate who did not like to be instructed by his female leader. She used a female-thinking pattern of letting a man decide what to be done for a day work on the vessel and kept his comfort zone as if he had a control, which was in fact the opposite. Both Ghanaian and German female Captains, on the other hand, expressed that their leadership identity was sometimes conflicting with their gender roles assigned in the home. They unconsciously tried to control their family members like a male family head, which caused a problem in their family relationship. This suggests that a leadership identity of female Captains can be associated with masculine norms and values, which work fine on board but could generate a serious gender-role gap while ashore.

6 Conclusion

Women tend to experience various obstacles in the process of their career development as seafarers. However, the research shows that a leadership position as a Captain would have a full potential for women. Female Captains in this study seemed to gain leadership skills in which some competencies were originated from their feminine qualities. Their leadership identity appeared to be 'gendered'

especially when they returned ashore and communicated with their family as a 'Captain of home' rather than a female family member.

The limitation of this research is the accounts from only Captains which can be subjective. It would be interesting to listen to their subordinates' views of how they perceive Captains' leadership in order to understand how their leadership is received and translated among their followers. However, such research design would be challenging, because subordinates may be afraid of the Captain and the researcher will not be able to disclose even anonymous voices of subordinates in the eyes of Captains who may find them. In addition to such ethical problems, it is practically almost impossible to interview the superior and subordinates on the same ship where the crew members are regularly changing over time. Seafarers have different contracts of voyage, determining the timing of when they come in and out.

The future research can expand its sample size to verify the emerged themes from this study and further investigate maritime leadership positions other than Captains, for example, Chief Engineers and Chief officers, or even shore-based decision-makers. This would extend to further discussions of human factors, impacting the dynamics of a shipboard crew relationship and the process of sending and receiving instructions concerning ship safety, security, and environmental protection. An inquiry into gender and leadership will therefore provide a new source of data for re-thinking human factors in the shipping industry.

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References

1. Belchers, P., Sampson, H., Thomas, M., Veiga, J., Zhao, M.: Women seafarers: global employment policies and practices. International Labour Office, Geneva (2003)
2. Kitada, M.: Rethinking the occupational culture of seafaring: challenges in the new era of cultural diversities. Ocean Law Soc. Manage. **3**, 80–97 (2011)
3. Kitada, M.: Women Seafarers and their Identities (Doctoral dissertation). School of Social Science. Cardiff University, Cardiff (2010)
4. Belchers, P., Sampson, H., Thomas, M., Veiga, J., Zhao, M.: Women seafarers: global employment policies and practices. International Labour Office, Geneva (2003)
5. International Maritime Health Association (IMHA), International Seafarers' Welfare and Assistance Network (ISWAN), International Transport Workers' Federation (ITF), Seafarers Hospital Society (SHS): Women Seafarers' Health and Welfare Survey. ISWAN, ITF, SHS, London (2015)
6. Azirh, N.T.: Women Merchant Mariners: Empowering West African Women to Go to Sea. Master's dissertation. World Maritime University, Malmö (2014)
7. Kitada, M.: Risking marriage and family: maintaining women seafarers' gender identities. In: The 1st SIRC-Nippon Fellow Maritime Conference: Maritime Matters in the 21st Century, pp. 3–21. Seafarers International Research Centre (SIRC), Cardiff (2009)
8. Ortega, O.D., Øverga rd, K.I., Henden, V.: Women are better leaders than they think: gender differences in the self- assessment of leadership skills in the maritime industry. In: Kitada, M.,

Williams, E., Froholdt, L.L. (eds.) Maritime Women: Global Leadership. Springer, Heidelberg (2015)
9. Goleman, D.: What Makes a Leader? Harvard Business Review. Harvard Business School Publishing Corporation, Brighton (1998)
10. Todnem BY, R., Hughes, M., Ford, J.: Change leadership: oxymoron and myths. J. Change Manage. **16**(1), 8–17 (2016)
11. McCall, M.W.: Leadership development through experience. Acad. Manage. Execu. **18**, 127–130 (2004)
12. Ausubel, D.P.: Educational psychology: a cognitive view. Holt, Rinehart, & Winston, New York (1968)
13. Okura, M., Uza, M., Izumi, H., Ohno, M., Arai, H., Saek, K.: Factors that affect the process of professional identity formation in public health nurses. Open J. Nurs. **3**, 8–15 (2013)
14. Daire, J., Gilson, L.: Does identity shape leadership and management practice? Experiences of PHC facility managers in Cape Town, South Africa. Health Policy and Planning, vol. 29, pp. ii82–ii97 (2014)
15. DeRue, D.S., Wellman, N.: Developing Leaders via experience: The role of developmental challenge, learning orientation, and feedback availability. J. Appl. Psychol. **94**(4), 859–875 (2009)
16. Hartsock, N.C.M.: The Feminist Standpoint Revisited and Other Essays. Basic Books, New York (1997)
17. Denzin, N.K., Lincoln, Y.S.: Handbook of Qualitative Research. Sage, Thousand Oaks (2000)
18. Kitada, M.: Code of behaviour at sea: women seafarers' shipboard identity management. WMU J. Marit. Aff. **12**, 213–227 (2013)

The Learning Organization in a Small Government Unit: Case Study of the Center for Academic Services, Srinakharinwirot University, Thailand

Unchana Klentien and Weeranan Kamnungwut

Abstract The research is R&D and aims to investigate and assess a learning organization in a government organization. A Learning Organization (LO) is one of the key developments in Thai government organizations. However, not many government organizations can successfully build and implement it in their organizational culture. This research studied and evaluated problems and methods of developing a LO in a small government organization named Center for Academic Services (CAS) at Srinakharinwirot University (SWU), which is a public university. CAS is a supporting unit of the university and is a semi-autonomous organization. Its main mission is to earn income for the university through providing academic services projects to both public and private organizations. Building up a learning organization could help CAS achieve its mission more effectively and efficiently. The CAS has sixteen staff working, which includes executives, who are lecturers and have been appointed by the university to work at the CAS apart from their teaching. The data collection methods were focus group discussions with questionnaires during the training on LO throughout the year. The data were analyzed by descriptive statistics, which are frequency, percentage, mean, and standard of deviation. The findings reflected six main characteristics of a LO, which are learning dynamics, personal mastery, mental model, shared vision, team learning and system thinking, and the findings showed that the CAS tended to be able to develop a LO in the organization.

Keywords Learning organization · Thai government organization · Center for academic services

U. Klentien (✉) · W. Kamnungwut
College of Social Communication Innovation, Srinakharinwirot University,
114 Sukhumvit 23, Bangkok, Thailand
e-mail: Unchana.kt133@gmail.com

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1 Introduction

An Organizational Culture is formed by everyone in an organization and accepted by the personnel in that organization. The culture presents a mainstream of the personnel's mindset, which inter-connects with the individual's attitudes, values and beliefs. The organization culture represents also the individual, team and organization's norms, policy, objective, technology, team status, and organization performance [7].

When an organization has a strong and outstanding culture, staff are more likely to work confidently and comfortably, and the effect is better efficiency (Amares Silaon [5]: 95). Furthermore, the effect makes staff feel safe and secure to be attentive and commit to the organization [6]. Therefore, culture is part of an organization and enhances the personnel's achievement for its operations and learning based on the organization's goal.

Organizational culture can be created and derived from clearly having a vision in an organization that is led by a determined executive or leader as a role model. Thus, an organization creates a learning organization to motivate and escalate its member to continuously develop their potential. A sustainable culture in an organization can then be preserved through the personnel's cooperation.

A learning organization is a strategy of an organization that focuses on human resource development by accumulating knowledge and intellectual property to maximize personnel's capacity to remain competitive. Thus, knowledge in the organization is a very important effective factor for organizational learning (OL).

In order to be an effective learning organization, knowledge management is a key. This means that an organization can manage its existing knowledge, seek for new knowledge and respond to changing and new environments. In so doing, the organization is learning.

Marquardt [2] explained the differences between a Learning Organization and Organizational Learning. LO is what the organization aims to be, whereas OL is a process of applying the methodologies to generate learning.

The organization that facilitates learning has principles and characteristics to inter-connect five components, which are: Learning Dynamics, Organization Transformation, Empowering and Enabling Staff, Knowledge Management and Adding Technological Power. These components allow an organization to make a change towards becoming a Learning Organization. The change process focuses on the four dimensions of the sub-system, which are: Vision, Culture, Strategy and Structure.

Several organizations have introduced the concept of a learning organization that emphasizes human resource development to maximize personnel's knowledge and ability to be able to manage the ever-changing environment that we all live in today. Learning becomes more popular because of the ideas that one needs to be better than one's competitors, so that personnel in each organization are constantly developing and enhancing their knowledge and skills through the learning process, and construct the actual system.

The concept of Learning Organization covers the learning at the individual level up through the organization level. A Learning Organization aims to develop a system for and enhance all executives and personnel's learning to be more effective and. constructive.

Center for Academic Services (CAS) at Srinakharinwirot University was selected as a case study on a Learning Organization in order to develop a prototype that can be replicated by similar government organizations that have interest in self-learning, self-development and participation of all members.

The assessment of the prototype model is expected to generate understanding about an organization's flexibility responding to diverse environments (including globalization), creating a learning atmosphere and managing knowledge systematically and continuously.

2 Research Objectives

(1) To develop a Learning Organization model at Center for Academic Services at Srinakharinwirot University.
(2) To investigate and assess the Learning Organization Model at Center for Academic Services at Srinakharinwirot University.

3 Reference and Related Research Literature

(1) **Learning Organization**
The general meaning of LO is to have an ideal learning environment where the staff continually expand their capacity to create the results they truly desire, where new and expansive patterns of thinking and creativity are nurtured, and where the staff are continually learning to see better the whole together.
According to Senge [4], the learning organization depends upon the mastery of five dimensions, which are (1) Personal Mastery, (2) Mental Model, (3) Shared Vision, (4) Team Learning, and (5) System Thinking.
Marquardt [2] advocates that a LO is an ideal organization that allows its member and team to transform themselves through the five components of learning together; the components are: Learning Dynamics, Organization Transformation, Empowering and Enabling Staff, Knowledge Management and Adding Technological Power.
(2) **Learning Organization Model at CAS**

The LO model at CAS means having a process or method for developing a LO that is generated by combining the findings of its problems and status with Senge's and Marquardt's theory. In order to be an efficient learning organization, the model

has been including learning at individual level and taskforce or working team level, and expanding to the organization level.

4 Method

The research is R&D research and aims to:

(1) Develop a Learning Organization model, and
(2) Investigate and assess the Learning Organization Model at CAS, SWU University.

5 Methodology

Part 1 Developing a Learning Organization Model at CAS, SWU University

There were five steps.

(1) Researcher synthesized the findings in CAS on the problems and status of LO management throughout the year of 2015, and then developed a model of LO at CAS.
(2) Researcher reviewed and studied the related literature and concept, especially Marquardt [2] and Senge's [4] theory on developing LO.
(3) Researcher drafted a model of LO based upon combining the findings of problems and status of CAS with the conceptual content of both related theories.
(4) A three-expert team investigated the draft of the LO prototype model of CAS.
(5) Researcher adjusted the model based upon the three-expert team's suggestion.

Part 2 Investigating and Assessing the Learning Organization Model at CAS

The researcher chose the purposive sampling technique of sixteen staff working at CAS, including executives and lecturers. The method of data collection was conducted through focus groups and with questionnaires during the training of LO throughout the year.

6 Tools for Conducting the Study

(1) Model of LO at CAS
(2) Training projects and activities at CAS
(3) Evaluation questionnaires on the operation of the LO at CAS, and Satisfaction Questionnaires for those who attended the training at LO of CAS

7 Timeframe

The study and analysis of the LO prototype model and its application had a duration of eight months.

8 Research Results

(1) Findings to Solve Problems and Improve Status

The assessment of the LO model focused on six characteristics: Learning dynamics, Personal mastery, Mental model, Shared vision, Team learning and System thinking. Table 1 below summarizes these findings.

Table 1 Summary on situation, status and problems, and conclusions

Situation, status and problem	Solve problems and improve status	Conclusions and activities/methods
(1) Learning dynamics		
• People in the organization ignore opinion of others • Staff are not opened-mind to exchange their opinion, thus results in less knowledge transformation	• Improve/adjust staff's constructive learning • Provide knowledge on learning how to learn • Articulate thoroughly learning at individual, team and organization levels	• Provide knowledge on creating a working environment • Provide a study tour to organization that has similar characteristic learning organization concept • Use IT to organize database of each unit
(2) Personal mastery		
• Staff are not working on the right skills • Staff lack concept on self development according to individual ability • Staff have no initiative to learn about their skills and ability for each unit	• Staff's vision should be adjusted to be compatible with organization's vision • Staff must balance stress in work place with creative fusion	• Organize training to staff who work at each unit • Provide knowledge on creating environment of learning in the organization • Organize participatory activities that allow staff to have conversation and dialogue
(3) Mental model		
• Staff do not have their own mental model for listening to mutual opinion • Staff do not dare to exchange their opinion	• Organization should provide an opportunity to staff to learn on a mental model • Enhance staff's knowledge and skills to deal with	• Integrate conversation and dialogue techniques in selected training projects (dialogue) • In order to achieve the mutual goals, include

(continued)

Table 1 (continued)

Situation, status and problem	Solve problems and improve status	Conclusions and activities/methods
with executive and colleagues, because after restructuring the executive has not yet developed a suitable mental model	change and problem by provoking their creativity	brain-storming technique in selected activities
(4) Shared Vision		
• Most of staff do not have understanding about the organization's vision • Individual visions are not compatible with organization's vision • Staff do not dare to exchange their opinion with an executive	• Executive should be able to design clearly shared vision together with staff • Executive should clarify the correlation of staff and vision, and eventually develop together an organization master plan • Executive and staff should develop plan of operation together	• Organize activities of creating and inter-connecting organization's shared-vision by presenting individual's vision, which includes executive and all staff • Set-up a monitoring process on projects or activities that support vision. (This is for further improvement.) • Develop an Operational Manual for each unit
(5) Team learning		
• Staff do not see any benefit of knowledge exchange for oneself or team • Staff expressed that they were too busy to talk and share experience with colleagues • Activities should be designed through informal learning	• Staff should strengthen individually interrelationship through communication and dialogue • The operation within team work should be transparent and honest, where one can learn from the fact in current situation • Develop and practice conversation daily on knowledge exchange that happened in the organization	• Organize activities that escalate staff to develop trust, be open-minded and be more transparent to colleagues • Organize sport day or any activities that staff can do together
(6) System thinking		
• Understanding of working system that needs coordination between staff	• Staff must emphasize a holistic picture of improving system thinking • Insert system thinking to enhance staff to better comprehend diverse situations and change of environment	• Organize activities that provide knowledge on technical and system thinking, as well as conduct Workshops • Develop an operation manual for each unit

The findings summarized in Table 1 were analyzed and synthesized from data collected, and also referenced to studies on Senge [4] and Marquardt's [2] theories.

The LO model developed focuses on six main characteristic of LO at CAS as following:

Learning Dynamics

A learning organization requires that its members have understanding about constructive learning and learning how to learn. This means that the center encourages a process where personnel are able to obtain new knowledge, which has influence on making behavioral changes. This results in changes in three domains of learning: cognitive, psychomotor and affective domain. The learning is an important factor in an organization. The organization requires having a continuous learning process, in order to influence the organization's personnel to increase their knowledge and understanding to the level of a learning organization. The learning process aims at three levels: (1) individual learning, (2) team learning, and (3) organization learning.

(1) **Personal Mastery**

CAS must develop their personnel to have versatile skills in order to correspond to its academics services that have been more diversified according to the fast and constantly changing environment. Personal mastery plays importance for self development in order to better achieve the CAS's goal, since staff's existing knowledge were probably not able to respond to new demands in a new environment. To be a competitor and survivor in these changes of trend, the center should also constantly support personnel to develop themselves.

(2) **Mental Model**

Personnel should develop a right mental model on their own thinking and opinions. Through self-experiences staff could reflect on matters such as prejudice, mindset and attachment. This result in self-learning generates new knowledge at the CAS. The right mental model enhances learning and influence all staff. Eventually CAS will have a frame for thinking and help staff to have a similar perspective on the direction of CAS.

(3) **Shared Vision**

Personnel have to help create the center's future picture or develop a shared vision. A good vision must specify the future picture of the center. It creates excitement and motivation, and creates a sense of commonality, and allows everyone to have the same purpose of achieving the center shared-vision. Most importantly, the executive must encourage all personnel at all units to define the center's vision.

(4) **Team Learning**

The center should encourage team learning through the knowledge exchange and personnel's thinking and trust building. A core of team learning begins with

personnel's consciousness in their work, followed-by continuous support activities that encourage personnel's collective learning and their exchanging knowledge and information provided by services center.

(5) **System Thinking**

The center should develop activities that encourage personnel to have an understanding of the organization's shared-vision and the inter-independence of each unit. The center should also develop a pattern and concept of system thinking for the whole center, as well as motivate all levels of personnel to emphasize self-learning. System thinking by personnel in the center is important in enhancing learning, which is inter-independently articulating integrated knowledge. New knowledge is a frame for clear inter-being. This has influence on mutual understanding of change.

(2) **Assessing the Learning Organization Model at CAS**

After creating the LO model, the researcher evaluated its efficiency and effectiveness of organizational learning.

2.1 Findings from focus group questionnaires

The researcher collected questionnaires from those who attended training and activities in order to evaluate the LO at CAS. The results have shown that attendants shared their positive opinion at a high level towards LO.

The following are their opinions:

(1) **Individual**

The learning by individuals at CAS is totally at a high level. In depth consideration of individual learning found that the mean of aptitude of knowledge transformation is the highest. It means that personnel, who are asked for help, are willing to give and share their knowledge to their colleagues. That person is able to simplify and clearly transfer his/her knowledge to colleagues.

The mean of receiver's aptitude is extremely high. It is interpreted that personnel had no hesitation to seek for help from their colleagues when dealing with problems and doubts. In order to get precise knowledge transformation, he/she observed, questioned, debated and recorded, and also showed interest in learning.

(2) **Task force or working team**

The learning of the working team at CAS is high. It can be interpreted that the mean of operation of LO at CAS is extremely high. It is known that there were diverse working-teams formed to transfer and exchange interesting knowledge in the CAS.

(3) **Organization**

The learning at CAS is high. It can be interpreted that the mean of learning at organization level is extremely high. It shows that the CAS developed its LO to OL - all personnel obtained training and taught to practice on how to learn.

9 Narrative of the Study Results

(1) Individual Learning is related to knowledge receiver's aptitude. Personnel have no hesitation to seek for help from their colleagues when dealing with problems and doubts. In order to get precise knowledge transformation, he/she observed, questioned, debated and recorded, and also showed interest in learning while acquiring for knowledge transferring.
(2) Individual Learning is related to knowledge provider's aptitude. Personnel, who are asked for help, are willing to give and share their knowledge to their colleague, and also able to simplify and clearly transfer their knowledge to colleagues.

The summary of point (1) and (2) (above) complied with Redding's theory, individual learning is a fundamental of organization revolution that expands its main capacity by preparing its member for uncertain future or changing environment. The most important factor that enhances the opportunity of individual learning is the relationship and bonding between personnel.

The opportunity in learning in each person is different, however an important technique and factor such as self directed-learning, learning from colleagues (working team), learning through computer, on the job learning, learning on assigned project, and also including instinctive learning will help enhance the learning of individuals. Thus, a Learning Organization should have alternative choices of learning.

Gill and Meier [1] defined that a key fundamental to accelerate learning is adding value to the learning environment, such as:

a. Providing a natural, comfortable, lively, and colorful setting.
b. Helping personnel eliminate or reduce any fears, stress or learning barrier.
c. Accommodating different learning styles, speeds and needs.
d. Presenting material pictorially as well as verbally.
e. Exalting rather than trivializing the personnel.

(3) Organization learning: The research finding is that personnel formed diverse working teams—based on their interests and responsibilities—to share and exchange their knowledge.

Panich [3] said that knowledge exchange is a method of transferring information from oneself to another, or from one group to another group. It includes the meaning of transformation of in-direct to directed knowledge through activities, coaching, mentoring, community of practice and workshops. It complied with Redding's explanation that LO will develop a radical team, while building capacity for continuous improvement, working across their line of operation, and accelerating the team quality for the Organizational Learning. The team is actualized as a tool for rehabilitating and changing the organization; therefore, they should have time for contemplating and practicing their action through the learning. The organization should not only support the team to solve a problem, but also to build an understanding about its flexible and responsive services (that alter from the previous) by creating collective teams learning process.

The learning, analytical thinking and implementation in team working will be quickly accelerated when they get an incentive for their participation. A high level of team learning will enhance the increased capacity for communication and brainstorming. This situation complies with Marquardt's [2] explanation that a LO is the capability to creatively and independently communicate and work. He also said that action learning is the most effective methodology for team learning.

10 Suggestions for the Next Research

(1) The assessment result of CAS learning organization prototype should be adopted to study in other government units that have similar vision and missions. This will enhance personnel to exchange their knowledge and develop the best practice to create flexible and effective organizations in solving its problems and uncertain climate.
(2) The assessment result of CAS learning organization model should be adopted to implement in other similar organization. Following on investigate and assess the result of its implementation in order to get its own model.
(3) The time frame of the research study on a learning organization should be longer than this research (8 months), as the organization can continue its development. This will result to a better and clearer learning organization.

References

1. Gill, M.J., Meier, D.: Accelerated learning takes off. Training Develop. **43**(1), 63–65 (1989)
2. Marquart, M.: Building the Learning Organization: A System Approach to Quantum Improvement and Global Success. McGraw-Hill, New York (1996)
3. Panich, V.: Knowledge Management in the Age of Knowledge Based Society and Economy. The Knowledge Management Institute, Bangkok (2003)
4. Senge, P.: The Fifth Discipline: The Art and Practice of the Learning Organization. Currency/Doubleday, New York (2006)
5. Silaon, A.: Organizational Culture. Style 7, Bangkok (2015)
6. Suebson, K.: Building Organizational Culture for Excellence. Se-ed Book, Bangkok (1992)
7. Werther, W., Davis, K.: Human Resources and Personnel Management. McGraw-Hill Inc, New York (1996)