



30TH Bled eConference

Digital Transformation – From Connecting Things to Transforming Our Lives

(June 18 – 21, 2017, Bled, Slovenia)

(Conference Proceedings)

Editors:

dr. Andreja Pucihar
dr. Mirjana Kljajić Borštnar
dr. Christian Kittl
dr. Pascal Ravesteijn
dr. Roger Clarke
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Preface

ANDREJA PUCIHAR

Bled eConference, organized by University of Maribor, Faculty of Organizational Sciences, has been shaping electronic interactions since 1988 and is celebrating its 30th anniversary in 2017. Bled eConference is the oldest, most traditional and well renowned conference in the field. It attracts speakers and delegates from business, government, information technology providers and universities and is the major venue for researchers working in all aspects of “e”. The theme of this year’s conference is dedicated to “Digital Transformation – From Connecting Things to Transforming Our Lives”.

The evolution of digital technologies and solutions (e.g. Internet of things, mobile technology, social media, cloud and high performance computing, artificial intelligence and advanced machine learning, virtual and augmented reality, big data & big data analytics, service architecture, digital technology platforms, 3D printing, robotics etc. ...) has significantly impacted on the way how business is conducted and had big implications on our lives. The nowadays digital economy calls for transformation of businesses, governments, education and societies as whole. It also calls for enabling policies and politics for cross border and global digital business.

Digital transformation is reflected in the organizations’ ability of comprehensive transformation of business activities, processes, competencies and business models in order to take advantage of digital technologies. Digital technologies require changes in our mind set, culture and functioning and have strategic impact on both the organization itself and its business ecosystems.

In this year’s conference, we address various aspects of digital transformation and provide directions and guidelines for organizations to overcome challenges on their way of successful digital transformation. Themes covered in the papers of these proceedings are focused to digital transformation challenges, opportunities and ccesses, furthermore to business model innovation, social media and big data analytics implementation, e-health, digital wellness and wellbeing experiences, new applications and organizational models, and novel approaches and cases in education in digital economy.

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Table of Contents

CONFERENCE PROCEEDINGS

A Systematic Approach to Terahertz-based Glucose Monitoring	7
Sasan Adibi, Lemai Nguyen & Andreas Hamper, Freimut Bodendorf & Nilmini Wickramasinghe	
Music Recommender Systems Challenges and Opportunities for Non-Superstar Artists	21
Christine Bauer, Marta Kholodylo & Christine Strauss	
POLO: A Framework for Short-term Studies Abroad to Enhance Critical Thinking Amongst Management Students	33
Riccardo Bonazzi, Micahël Poli & Natalie Sarrasin	
A Co-Creation Based Model For Engaging Citizen Open Data Use	47
Colin Callinan, Murray Scott, Eoin Whelan & Adegboyega Ojo	
Digital Coaching to Build Sustainable Wellness Routines for Young Elderly	57
Christer Carlsson & Pirkko Walden	
The Relation Between Process Management and Innovation – A Comparison of the IT and Manufacturing Industries	71
Thom Cats & Pascal Ravesteyn	
Content Analysis in Support of Critical Theory Research: How to Deliver an Unwelcome Message Without Being Shot	87
Roger Clarke	
The Impact of Cloud-Based Digital Transformation on ICT Service Providers' Strategies	111
Trevor Clohessy, Thomas Acton & Lorraine Morgan	
Decision Makers and Criteria for Patient Discharge - A Qualitative Study	127
Isabella Eigner, Andreas Hamper, Nilmini Wickramasinghe & Freimut Bodendorf	

Analysing Digital Transformation among Hungarian Organizations	139
Péter Fehér, Zoltán Szabó & Krisztián Varga	
Using Design Thinking to Identify Banking Digitization Opportunities - Snapshot of the Hungarian Banking System	151
Péter Fehér & Krisztián Varga	
Use of Facebook and Google Platforms for SMEs Business Model Innovation	169
Rimantas Gatautis, Elena Vitkauskaitė & Mark de Reuver	
The Impact of Clinical Information Systems on Patient Outcomes and Organisational Performance	183
Peter Haddad, Jonathan Schaffer & Nilmini Wickramasinghe	
Innovation in Micro, Small and Medium Sized Enterprises: New Product Development, Business Model Innovation and Effectuation	197
Jukka Heikkilä & Marikka Heikkilä	
The Playful Learning Approach for Learning how to Program: A Structured Lesson Plan	215
Robert Heininger, Victor Seifert, Loina Prifti, Matthias Utesch & Helmut Krcmar	
Emerging Smart Technologies and the European Standardisation System	231
Kai Jakobs	
Intruder Alert? How Stock Markets React to Potential IT Security Breaches: The Case of OpenSSL Heartbleed	245
Christian Janze	
Coworking from the Company's Perspective - Serendipity-biotope or Getaway-spot?	263
Barbara Josef	
Wellness Technology Use in Everyday Life: A Diary Study	279
Tuomas Kari, Eeva Kettunen, Panu Moilanen & Lauri Frank	

Activity Trackers Influencing Motivation and Awareness: Study Among Fitness Centre Members	295
Eeva Kettunen, Tuomas Kari, Maria Chasandra, Will Critchley & Umut Doğan	
CustomerSourcing: Intrinsic Motivators	313
Fred Kitchens & Cameron Crane	
A First Step Towards Learning Analytics: Implementing an Experimental Learning Analytics Tool	323
Justian Knobbout & Esther van der Stappen	
Personalizing Narratives to Support Motivation for Physical Activity	335
Olli Korhonen, Michael Oduor & Minna Isomursu	
Serious Games in Healthcare: Results from a Systematic Mapping Study	349
Tanja Korhonen & Raija Halonen	
Designing an IoT-enabled Gamification Application for Energy Conservation at the Workplace: Exploring Personal and Contextual Characteristics	369
Dimosthenis Kotsopoulos, Cleopatra Bardaki, Stavros Lounis, Thanasis Papaioannou & Katerina Pramatarı	
Consumer Emotions and E-commerce: A Literature Review	385
Matias Lievonon	
Age Differences in Technology Readiness and Its Effects on Information System Acceptance and Use: The Case of Online Electricity Services in Finland	403
Markus Makkonen, Lauri Frank & Kerttuli Koivisto	
Local Online Platforms – Surviving in a Global Market	421
Anton Manfreda, Peter Trkman, Aleš Groznik & Jure Erjavec	
Conceptualizing Digital Transformation in Business Organizations: A Systematic Review of Literature	427
Resego Morakanyane, Audrey Grace & Philip O'Reilly	
The Appraisal of Facebook Online Community: An Exposition of Mobile Commerce in Social Media Reviews	445
Sunday Adewale Olaleye, Ismaila Temitayo Sanusi & Jari Salo	

Coupons from Deal Sites as Gifts: Impact of Gender, of Age, and of Personality Traits	461
Antonin Pavlicek & Frantisek Sudzina	
Combining Digitization with Healthcare Service Processes: Value Co-creation Opportunities Through Standard Work	471
Katja Rantala & Heikki Karjaluo	
IT on the Shop Floor - Challenges of the Digitalization of Manufacturing Companies	483
Alexander Richter, Shahper Vodanovich, Melanie Steinhüser & Lea Hannola	
Airport Operations Modelling: Agent Based Modelling of Ground Crews	501
Blaž Rodič & Alenka Baggia	
Understanding New Emerging Technologies Through Hermeneutics: An Example from mHealth	519
Zaid Zekiria Sako, Sasan Adibi & Nilmini Wickramasinghe	
Designing and Implementing Common Market for Cross-Game Purchases between Mobile Games	531
Erkki Siira, Elina Annanperä, Otto Simola, Samuli Heinonen, Jani Yli-Kantola & Jari Järvinen	
Diabetes Lifestyle (e)Coaching 50 Weeks Follow Up; Technology Acceptance & e-Relationships	545
Luuk P.A. Simons, Hanno Pijl, John Verhoef, Hildo J. Lamb, Ben van Ommen, Bas Gerritsen, Maurice B. Bizino, Marieke Snel, Ralph Feenstra & Catholijn M. Jonker	
Developing a Mobile Application for Managing Anaphylaxis: Discovering Critical Success Factors	561
Koen Smit, Joris Mens & Matthijs Berkhout	
Transforming Clinical Practice Guideline Usage Through the Use of a Clinical Decision Support System: An explorative study at the University Medical Centre Utrecht	577
Koen Smit, Pieter Koornneef, Julie Nysingh, Mart van Zwienen, Matthijs Berkhout & Pascal Ravesteyn	

Propensity to Click on Suspicious Links: Impact of Gender, of Age, and of Personality Traits Frantisek Sudzina & Antonin Pavlicek	593
Do Online Travel Communities Matter? A Literature Review Dandison C. Ukpabi, Ukamaka D. Onyenucheya & Heikki Karjaluo	603
Cultural Values Inherent in the Design of Social Media Platforms: A Case Study of WeChat Shahper Vodanovich, Brad McKenna & Wenjie Cai	617
Success Factors for Effective Customer Interaction in Digital Sales: a Case from the Digital Investment Service Industry Rüdiger von Nitzsch, Dirk Braun & Roger W.H. Bons	629
Wearables and Wellness for the Young Elderly - Transforming Everyday Lives? Camilla Walden & Anna Sell	637
Reviewing Organizational Design Components for Digital Business Strategy Timo Weinrich	651
Behaviour Intentions to Use RFID Subcutaneous Microchips: A Cross-sectional Slovenian Perspective Borut Werber, Alenka Baggia & Anja Žnidaršič	669
Customer Context and Social CRM: A Literature Review and Research Agenda Matthias Wittwer, Olaf Reinhold & Rainer Alt	685
ERP Solution Acceptance by Students Simona Sternad Zabukovšek & Samo Bobek	703
Characterization of Business Model Research: Bibliometric Analysis and the Future Agenda Ivan Župič, Marko Budler & Peter Trkman	719

DOCTORAL CONSORTIUM

**Information Management in Supply Chain Partnering: Improving
Maintenance Processes in Dutch Housing Associations** **733**

Debby Goedknecht

**Personalization in Digital Services: Information Technology
Supporting Service Personalization Process** **749**

Doctoral Consortium – Research Proposal

Olli Korhonen

A Systematic Approach to Terahertz-based Glucose Monitoring

SASAN ADIBI, LEMAI NGUYEN, ANDREAS HAMPER, FREIMUT BODENDORF &
NILMINI WICKRAMASINGHE

Abstract This paper focuses on the design and development of a non-invasive smart and pervasive mobile solution to measure blood glucose without the need for drawing blood or pricking fingers. Specifically, it examines the possibility of sensors using Terahertz (THz) technology to measure blood glucose. This paper reports on a research in progress looking at identifying and then designing superior strategies for measuring blood glucose. It presents the central role that measuring blood glucose plays in diabetes care management. It then highlights the current methods and problems and concerns with finger pricking. From there, the paper proffers a non-invasive solution using THz technology to measure blood glucose and outlines the approach to design and develop such a solution using a decision science methodology.

Keywords: • health informatics • mHealth • diabetes • blood glucose monitoring • non-invasive • terahertz •

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1 Introduction

Diabetes is a chronic disease that occurs when there is too much glucose in the blood because the body is not producing insulin or not using insulin properly (Diabetes Australia, 2007). As noted by the WHO (World Health Organization, 2016), diabetes is at epidemic proportions globally and needs to be addressed. Diabetes management involves a combination of both medical and non-medical approaches with the overall goal for the patient to enjoy a life which is as normal as possible (Australian Institute of Health and Welfare, 2007, 2008). As there is no cure for diabetes, diabetes must be regularly managed and monitored. Critical to this management regimen is the systematic monitoring of blood glucose levels. However, achieving this goal can be challenging because it requires effective lifestyle management as well as careful, meticulous attention and monitoring by the patient and health professionals (Britt et al., 2007). There is a need for identifying a simple and convenient non-invasive approach to monitoring blood glucose (So et al., 2012). This forms the focus of this research.

2 Background

2.1 Invasive, Semi-Invasive, and Non-Invasive Solutions

A key factor in the management of diabetes has been found to be the patient's self blood glucose monitoring (SBGM) (Guerci et al., 2003; Haller et al., 2004; Karter et al., 2001). As a result of recent research (Farmer et al., 2009; Malanda et al., 2012), General Practice Management of type 2 diabetes (RACGP and Diabetes Australia, 2014-2015) recommends SMBG for patients with type 2 diabetes who are on insulin. Currently, the dominant method to test blood glucose level is invasive. It requires a blood glucose meter, a lancet device with lancets, and test strips. Further, the patient must prick their finger with the lancet sometimes more than four times a day. Finger pricking in SBGM has been found to have several clinical and psychological disadvantages. These are described below.

Clinically, there is a risk of skin infection and tissue damage. Repeated finger pricking associated with the depth and possible vibrations of the needle tip while penetrating the skin were found to cause soreness (Burge, 2001) and damage the skin and in severe cases could lead to ulcer on their patient fingers (Dahiya et al., 2012; Giannini & Mayr, 2004). Therefore, this SBGM practice can result in damage to the patient body site.

Further, SBGM using a finger prick glucometer is not practical for continuous monitoring of blood glucose (So et al., 2012). As blood glucose levels of a patient change overtime, possible occurrences of hyperglycaemia or hypoglycaemia between measurements may not be recorded. Thus, the measurements may not truly reflect the patient blood glucose pattern (Kannampilly, 2013).

Psychologically, inconvenience and anxiety of constant performing finger pricking and extracting a drop of blood in patients' daily lives, and associated physical and emotional pain have always been troublesome in SBGM (Burge, 2001; Karges et al., 2008; Pacaud et al., 1999; Wainstein et al., 2013). In a cross-sectional questionnaire survey with 315 patients with diabetes in the UK, about one third of general diabetes patients were found to have anxiety to finger pricking for SBGM (Shlomowitz & Feher, 2014). Positive correlations were found between anxiety due to finger pricking and avoidance of testing as well as between anxiety due to finger pricking and general anxiety. In previous studies (Burge, 2001; Cradock & Hawthorn, 2002; Koschinsky, 2007), pain and discomfort were consistently found to cause a natural resistance to SBGM, and subsequently result in a lack of adherence to this procedure. Anxiety due to the finger prick method and avoidance of testing were found across different ethnic groups and female patients were found to have greater anxiety to finger pricking SBGM (Shlomowitz & Feher, 2014).

The aforementioned disadvantages served to motivate the need for new approaches to SBGM. They can be categorised into two groups. The first group is to support for measuring blood glucose levels in a less painful manner. Wainstein et al. (2013) used a CoolSense device to reduce local pain sensation due to finger pricking. They conducted an experiment with 177 adult patients with type 2 diabetes and concluded that the CoolSense device significantly reduced subjective pain felt by the patients while maintaining the same level of clinical accuracy. Other studies suggest that instead of pricking fingers, patients can prick other areas such as the forearm, knee, earlobe, thigh and abdomen skin (Castilla-Peón et al., 2015; Heinemann, 2008; Nakayama et al., 2008). While pricking alternative body sites were commonly found to reduce pricking fingers to some extent, it did not eliminate the pain completely. Disadvantages of pricking other body sites include lack of accuracy, inconvenience and difficulty of pricking in public, and technology switching costs to purchase new equipment for pricking and measurement (Castilla-Peón et al., 2015; Cradock & Hawthorn, 2002; Heinemann, 2008).

The second group of approaches to SBGM is to developing semi-invasive and non-invasive technologies for blood measuring without needle pricks (Makaram et al., 2014; So et al., 2012). Du et al. (2016) propose a biosensor that can detect low-level glucose in saliva. They conducted a study of ten healthy human subjects and conducted that the proposed biosensor can be seen as a potential alternative to SBGM using finger pricking. The protocol of use is still rather complex, consisting of nine steps requiring the patient to chew a sponge in his/her mouth to collect saliva, and later squeeze the collected saliva into the device with a sensor, thus is not easy to use. More studies are required to investigate the accuracy of sensors in detecting low salivary glucose levels, efficiency and practicality of the proposed approach. Zhang et al. (2011) review current developments of non-invasive continuous SBGM methods using ocular glucose. These authors review studies in ocular glucose monitoring: (1) using contact lens-based sensors and (2) using nanostructured lens-based sensors. They concluded that lens sensors have the potential to monitor a wide range of glucose levels quickly and accurately, however there is a safety concern because boronic acid and concanavalin A may be released from

the lens into the patient body. Nanostructured lens-based sensors have several advantages (for example better accuracy and sensitivity, less interference with patient vision), further studies are required to improve resolution and sensitivity of the lens, and to determine physiological relevance and baseline tear glucose concentration (Zhang et al., 2011). Another review of current nanomaterial-based solutions using saliva, sweat, breath and tears as a medium for SBGM suggests that they are far from optimal; further nanotechnology sensing devices need to be manufactured at a low cost to compete with established blood glucose meters (Makaram et al., 2014).

One of the most recent advances in the area of semi-invasive glucose monitoring is Abbott's Freestyle Libre System (HT Correspondent, 2015) which is based on a body attached sensor and a smartphone loaded with the application (Figure 1, adapted from HT Correspondence, 2015). This disposable body attached device (sensor) is equipped with a thin and flexible fibre needle, which is the only invasive part, however the fibre is inserted only once and under the skin of the back of the arm. The sensor can be used continually for 14 days without the need to be replaced. The sensor captures glucose concentration information and once the smartphone that runs the required app scans the sensor, the current and up to 8 hours of glucose levels are read and uploaded to the smartphone (Timothy et al., 2015)



Figure 1: Freestyle Libre System, (adapted from Hindustan Times, HT Correspondent (2015)

According to Timothy et al. (2015), the accuracy of the FreeStyle Libre system as dependent function of a number of patient-related factors (e.g., diabetes type, gender, insertion site/administration, body mass index, hemoglobin A1c "HbA1c", age, and rate of change) has been found to be above 85.2% up to 14 days of testing.

Overall, studies in issues associated with SBGM using finger pricking devices and learnings from in current developments of new SBGM methods suggest the following key factors: technology (technical soundness, sensitivity of device, and sufficient quantity and reproduction of medium), clinical accuracy (accuracy of measures, continuity of monitoring), clinical and safety interference with vision patient vision (infection, damage to patient body sites, release of chemicals to patient body, interference with patient vision), ease of use (level of invasiveness, practicality of sample collection and protocols of use), psychological effects (pain and discomfort, anxiety, fear, inconvenience and difficulty of performing tests in public), and costs (manufacturing costs and patient technology switching costs). We develop Table 1 to present the key aspects of problems and concerns identified in the extant literature relating to SBGM.

We conceptualise the problem in diabetes care management with the above factors. Therefore, we propose an approach to solution development consisting of patients analytics to focus on the targeted patient cohort, design science engaging patients in testing when it's safe, not early design, to finally propose a new solution to address their concerns and ensuring appropriate monitoring of the care management plan.

Table 1: Problems and concerns in current SBGM methods

Key aspects	Factors
Technical feasibility	Sufficient quantity and reproduction of medium (Makaram et al., 2014). Sensitivity of device (Zhang et al., 2011) Technical soundness (Makaram et al., 2014; So et al., 2012)
Clinical accuracy	Accuracy of result (Castilla-Peón et al., 2015; Nakayama et al., 2008; Timothy et al., 2015) Continuity of monitoring (Kannampilly, 2013; So et al., 2012)
Side effects and safety	Infection (Dahiya et al., 2012; Giannini & Mayr, 2004) Physical damage to the body site (Burge, 2001; Dahiya et al., 2012; Giannini & Mayr, 2004) Release of chemical to body (Zhang et al., 2011) Interference with vision (Zhang et al., 2011)
Easy of use	Level of invasiveness (Castilla-Peón et al., 2015; Heinemann, 2008; So et al., 2012; Wainstein et al., 2013). Practicality of device, sample collection and protocols of use (Du et al., 2016; Heinemann, 2008)
Psychological effects	Pain and discomfort (Burge, 2001; Heinemann, 2008; Karges et al., 2008; Koschinsky, 2007; Pacaud et al., 1999; Wainstein et al., 2013) Anxiety and distress (Cradock & Hawthorn, 2002; Shlomowitz & Feher, 2014) Fear of needles and blood (Burge, 2001; Shlomowitz & Feher, 2014) Inconvenience and difficulty of performing tests in public (Castilla-Peón et al., 2015; Heinemann, 2008)
Costs	Manufacturing costs (Makaram et al., 2014) Patient technology switching costs (Heinemann, 2008)

2.2 Non-Invasive Terahertz Technology Solution

The ultimate approach in managing diabetes is based on non-invasive solutions, one approach is using Terahertz technology which is the focus of this section. Terahertz refers to the electromagnetic waves with the frequency range between millimetre-wave and infrared, approximately from 100 GHz up to 10 THz (see Figure 2 adapted from Adibi, 2013). The THz spectrum, also known as the “terahertz gap” is the last portion of the electromagnetic spectrum which has not been fully explored and exploited (Tonouchi, 2007). Terahertz technology is a fast-growing field with applications in biology and medicine, medical imaging, material spectroscopy and sensing, security, monitoring and spectroscopy in pharmaceutical industry, and high-data-rate communications.

In biomedicine, Terahertz technology has so far been used in variety of medical applications, including: skin/breast cancer detection, wound inspection, and dental imaging (Panwar et al., 2013; Yang et al., 2016).

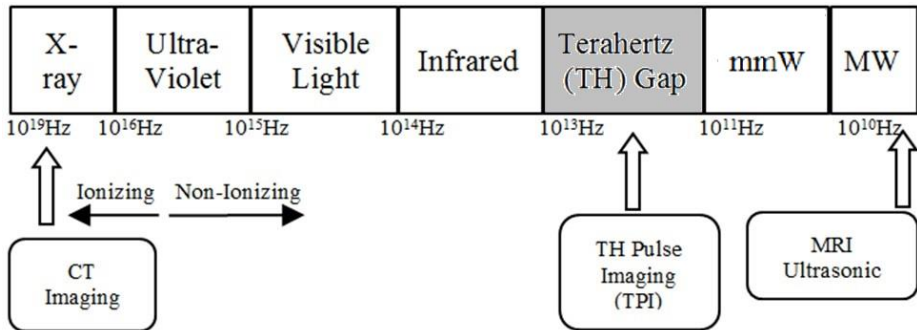


Figure 2: Frequency Spectrum of EMR Imaging Technologies, adapted from Adibi (2013)

The THz studies have uniquely revealed that medical image diagnoses are possible over wide range of tissues, however much further detailed analyses are required to identify the degree of precision achieved in monitoring blood glucose concentration using THz technology.

3 Proposed solution

The technology methods behind the operation of this solution’s proof of concept are based on the following approaches (Jackson et al., 2011):

- Terahertz time-domain spectroscopy (THz-TDS)
- Terahertz frequency-domain spectroscopy (THz-FDS)
- Terahertz imaging using non-destructive evaluation (NDE)

These methods are considered to pinpoint the best option for blood-glucose level monitoring from the transmitter/receiver perspectives. The THz transmitter, the operational power, energy consumption level, and safety factors are of significant importance since the solution is ultimately deployed in a smartphone application.

From the mentioned approaches, the THz-TDS approach has shown promising behaviour since it was used to measure the full dielectric-based function representing as the absorption coefficient and the refraction index of glucose and galactose between 0.2 THz to 3.0 THz (Zhang, 2008). A few distinct absorption features are identified as the signatures of intra- and intermolecular modes of the hydrogen bonded crystalline structure.

The design of the related app that runs on the smartphone platform requires a number of features, including: a fast Digital Signal Processing (DSP) system based on the microcontroller system used in the Arduino platform. The hardware side of the system consists of an open-source 32-bit Atmel ARM processor, which is capable of running fast concurrent processes. The software system features a fast and optimised image processing algorithm aided with Kalman filtering for higher accuracy. The high accuracy results are needed due to highly variable testing environment (handheld application). The system also features remote monitoring and cloud-computing capability. The proof-of-concept involves the identification of the optimal THz sensor, power, frequency spectrum, and reflection analysis for the most optimal application of the Terahertz technology in monitoring under-skin blood glucose levels.

The framework is the continuation of the work of reference (Shen et al., 2002), which is based on the Fourier Transform Infrared (FTIR) Spectroscopy. This reference shows the successful deployment of infrared in detecting glucose level of the blood. The lessons learned from this work can directly be used in this project.

Once the specific THz approach is selected, the methodological approach is to model the existing solutions and study the physical behaviour of Terahertz technology when radiated onto the human skin and study the depth of penetration and the variations in the reflections. This requires sophisticated THz lab equipment to run experiments on a test dummy, which mimics the human skin and underlying soft tissues. The results between the traditional needle-based sensing are then compared and the precision figures for the Terahertz-based method are evaluated. Then the approach need to be fine-tuned and also other health issues (e.g., technology implications, training, health-hazards, etc.) are then considered.

4 Proposed solution

A Design Science Research Methodology (DSRM) will be used to operationalize this research. This approach is particularly appropriate where improving an existing solution is desired and/or there is a need for a new solution to address specific unsolved or unique aspects (Hevner & Chatterjee, 2010; Hevner et al., 2004). DSRM as a process model to carry out research is widely used in the information systems research to create new solutions or to improve existing ones. DSRM process model consists of six process elements (Peffer et al., 2007), starting from identifying the problem and the motivation to conduct research, and concluding with communicating the results and outcomes of the research. Table 2 maps the proposed project to DSRM process elements (Peffer et al., 2007).

Table 2: Mapping the proposed research to DSRM

DSRM process elements	DSRM description	Application on this study
Problem identification and motivation	Defining the specific research problem and justifying the value of a solution based on knowledge of the state of the problem.	With the increased diabetes population, and the disadvantages of conventional blood glucose tests, the lack of a reliable and easy to use non-invasive technology to monitor blood glucose motivates this research.
Definition of objectives of the solution	The objectives can be qualitative or quantitative i.e. create or improve an artefact respectively based on knowledge of the state of the problem and current solutions, if any, and their efficacy.	The objective is to create and refine an artefact; i.e. the sensors.
Design and development	Creating the artefact, including the desired functionality and its architecture based of knowledge of theory that can be used to bear in a solution. This is usually an iterative process.	Through several iterations the exact range for the frequency for the needed Terahertz wave beam will be identified. Once the narrow range for the frequency for the Terahertz wave is identified, the CAD/CAM programming will occur.
Demonstration	Demonstrate the use of the artefact to solve the problem.	Simulation-based: This will be done in a lab using their simulation set up and mannequins. Clinical: Demonstration of the use of a new device to a sample of targeted patient population.
Evaluation	Iterate back to better design the artefact if needed.	Simulation-based: As needed, iterations will take place, to fine tune the needed range for the Terahertz wave projections. Clinical: Iterative evaluations to ensure that the prototype is truly tailored to meet clinical requirements for the targeted population.
Communication	Publish and let the value of the solution talk about itself.	This will include conference publications, journal publications and other presentation activities.

5 Results and Next Steps

Based on our systematic review of the literature to date, we have identified problems and concerns with the current methods for blood glucose monitoring as well as the need for a simple, accurate non-invasive solution to it. To address this void we have proffered a technology solution using sensor technology combined with a smart phone. The next steps now include the design and development of the solutions coupled with establishment of proof of concept, usability and fidelity. This involves four key steps as follows:

Phase 1: This phase will involve the conducting of multi-dimensional analysis of provided data sets from a diabetic population (in China). The results will provide a clear picture of the current state, reveal critical trends and important patterns regarding this population and assist to identify the patient sample. It is anticipated that target patient cohorts and their demographics as well as geographic and clinical characteristics will be identified for the project to identify who would benefit most from the non-invasive smart solutions. This phase aims to address the first DSRM process elements including problem identification and motivation, and definition of objectives of the solution (see Table 2).

Phase 2: Phase 2 will include designing and developing the appropriate sensor technology. The patented solution we have developed uses THz to identify blood sugar readings but this requires critical analysis to isolate the specific THz band. Inputs for this are derived from aspects of the data analytics performed in phase 1 above. Once this is done the required specifications for designing the sensors must be generated. Thus the results at the end of this phase include the design specification for the sensors to be used in the specific context so they are truly tailored to that context. This phase aims to address the subsequent DSRM process elements including design and development, simulation-based demonstration, and associated simulation-based evaluation.

Phase 3: Phase 3 will focus on the design and development of the software solution necessary to develop the prototype to be used to measure blood glucose readings. Contemporaneously, the health literacy issues will be examined and an appropriate education and coaching program will be developed for the targeted population. This phase aims to continue the DSRM process element design and development.

Phase 4: Phase 4 involves establishment of proof of concept, usability, fidelity and functionality. This will be conducted by running a field study on the selected patient population of 50 patients based on results from phase 1. It is anticipated that the field study will involve an iterative process to ensure that the prototype is truly tailored to the selected population's needs and requirements. In addition, HbA1C the standard diabetes marker will be tested at 3 month intervals over a 6 month time frame to assess success of the solution and changes to health literacy at these points will also be assessed. This phase aims to address the DSRM process elements including clinical demonstration, and clinical evaluation using the key aspects (technical feasibility, clinical accuracy, clinical

side effects and safety, ease of use, psychological effects, and costs) and relevant factors presented in Table 1. As a result, the list of factors will be refined to inform future implementations and evaluations.

The DSRM process element communication will take place through the whole project when findings from each phase become available.

6 Discussion and Conclusion

Concurrent and independent from the exponential rise of diabetes has been the rise of mobile and sensor technology. The maturing and sophistication of these technologies has enabled them to be used in many aspects of healthcare and wellness management. The preceding has served to outline another potential area for the adoption of mobile and sensors; namely, to assist with a non-invasive approach for the monitoring and management of diabetes. Specifically, we have identified an opportunity to use Terahertz frequencies to detect blood glucose levels in individuals. Further, we envisage designing and developing this solution by combining sensors with a mobile phone so that detection of blood glucose can not only be non-invasive but truly pervasive.

The implications for theory and practice are wide and far reaching. From a theoretical perspective we combine two technology genres mobile and sensors to address a healthcare issue – detection of blood glucose levels using a design science research methodology. This can lead to a better understanding and application of sensor technology in mobile technology. Scientifically backed roadmaps for including innovative sensors (i.e. terahertz sensors) in mobile technology can support further DSRM based research in the field. From the perspective of practice, diabetes as noted by World Health Organization (2016) is global and at epidemic proportions with an estimated of 422 million adults living with diabetes in 2014, and 1.5 million deaths caused by diabetes in 2012. Complications from diabetes can lead to other serious conditions such as heart attack, stroke, blindness, kidney failure and lower limb amputation. Further, the number of pre-diabetic individuals is also considerable. Monitoring and management is the only recognised strategy to maintaining appropriate blood glucose levels and thereby managing diabetes and/or preventing a pre-diabetic becoming a diabetic. Given, the problems and criticisms of finger pricking and other invasive approaches to SBGM, the most prevalent approach to testing blood glucose using a non-invasive Terahertz technology solution which we propose is very attractive to individuals. By learning from glucose monitoring, there is an opportunity to transfer the use of Terahertz technology to test other blood values in a non-invasive way. When such a solution is truly pervasive, it becomes even more attractive. Thus, we believe that the proffered solution will enable diabetic and pre-diabetic individuals to enjoy a better quality approach to monitoring and managing their blood glucose levels.

Our future work will focus on establishing usability, fidelity and acceptability of the proffered non-invasive pervasive solution

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Music Recommender Systems Challenges and Opportunities for Non-Superstar Artists

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Abstract Music Recommender Systems (MRS) are important drivers in music industry and are widely adopted by music platforms. Other than most MRS research exploring MRS from a technical or from a consumers' perspective, this work focuses on the impact, value generation, challenges and opportunities for those, who contribute the core value, i.e. the artists. We outline the non-superstar artist's perspective on MRS, and explore the question if and how non-superstar artists may benefit from MRS to foster their professional advancement. Thereby, we explain several techniques how MRS generate recommendations and discuss their impact on non-superstar artists.

Keywords: • Music Recommender Systems • Non-superstar artists • Popularity bias • Online Business •

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1 Introduction

In the era of digitalisation, music has become easier to create, distribute, and access than ever. Music recommender systems (MRS) are meant to assist listeners in navigating through the myriad of available musical works and provide them with suggestions that would fit their preferences and needs. This paper aims to present the most common techniques in music recommendation and how these affect the positions of non-superstar artists. While previous research on MRS typically takes a technical perspective or focusses on the consumers, the artists' perspective has yet largely been neglected. "The phenomenon of Superstars, wherein relatively small numbers of people earn enormous amounts of money and dominate the activities in which they engage, seems to be increasingly important in the modern world" (Rosen, 2004, p. 215). Still, the impact of MRS on non-superstar artists is particularly important as (i) the vast majority of artists are non-superstar artists (Anderson, 2004; Mulligan, 2013), (ii) the economic situation of non-superstar artists is usually precarious (Bauer & Strauss, 2015), and (iii) the technological and managerial skills required to manage and promote one's own business as an artist are usually not part of the typical educational paths of aspiring artists (Bauer, 2012; Bauer, Viola, & Strauss, 2011).

The importance of non-superstar artists is further underpinned by the "long tail" concept introduced by Anderson (2004, 2006), a model that is specifically applicable to the music industry. This model describes the economic tendency, when there is a concentration of sales on the most popular items ("hits"), which form the head, and then a long tail of less popular items that may fulfil niche demands of potential customers. This model is considered the opposite of the "hit model" (or "short tail") in industries where an item either becomes a "hit" or does not make any profit at all. The implication is that it is more profitable to sell small amounts of the long tail of less popular items than large amounts of a small number of hits. Later, empirical findings (e.g., Brynjolfsson, Hu, & Simester, 2007) confirm this idea, provided there are effective search and recommender systems available that enable users to access these long-tail items easily. At the same time, MRS is an enabler to introduce niche items to a consumer who usually follows hits only in such a sophisticated (preference-matching) manner, so that this hit-affine user may start consuming long-tail products (Goel et al., 2010). As a result, the employment of recommender systems in the long-tailed online music market enables users to discover and access the work of non-superstar artists.

The paper is structured as follows: Section 2 provides a structured overview MRS and their functionality. In Section 3 we explore the influence of MRS on non-superstar artists by explaining the phenomenon of popularity bias, the cold start problem, and superstar economy. Section 4 provides details and results of a semi-structured interview with an artist, followed by the last section containing concluding remarks.

7 Music Recommender Systems

This section provides an overview of the structure of MRS, its components and functionality, and the most common techniques used.

Typically, recommender systems consist of three key components: users, items, and user-item-matching processes. This general structure also applies for MRS, where users are the listeners and items are the music items (music works). The system collects relevant data about its users and applies mathematical models and diverse techniques to find and propose items, which might be of interest for the listener. To recommend items that most likely fit the listeners preferences the system needs to manage data about listeners and music items, the system generates profiles for each of them and determines “good” matches by comparing these profiles (Song, Dixon, & Pearce, 2012). In the following, we discuss in detail the data and approaches associated with the three key components, i.e., user, item and matching.

7.1 User Data

In order to be able to make valid recommendations, an MRS requires data about its users’ needs. However, getting such exact data is a costly process (Turnbull, Barrington, & Lanckriet, 2008). Thus, MRS rely on user modeling. The system analyses its users’ data and generates profiles based on their differences to model music preferences and thus determine which music items might be of interest for the individuals. Typically, the user modeling process consists of two sub-processes: (i) user profile modeling and (ii) user experience modeling. User profile modeling is generally used to determine the “position” of the listener in comparison to others based on their features. One of the approaches suggests dividing user profiles based on three major categories: demographic, geographic, and psychographic (Celma, 2008). Further, a number of attributes can be assigned to each category, such as age, gender, country, interests, etc. (Song, Dixon, & Pearce, 2012). Whereas, user experience modeling is meant to approach the users with consideration of their music expertise level, which further can be used to determine some of their expectations towards the MRS (Jennings, 2007; Song, Dixon, & Pearce, 2012; Uitdenbogerd & Van Shyndel, 2002). Combining both approaches, it is possible to predict some of the users’ demands and desires regarding music; for instance, it is possible to predict a user’s preferred ratio of new, previously unknown vs. popular, already known music items she would like to listen to when engaging with a music platform (Anderson, 2006). Some data can be obtained through observing listeners in their actions on the music platform, such as listening patterns (Shao et al., 2009; Song, Dixon, & Pearce, 2012), other data may be retrieved through input inquiries, e.g., surveys to retrieve profile information (Song, Dixon, & Pearce, 2012).

7.2 Music Item Data

Item profiles are based on the metadata of music works. Such item metadata typically differentiates three types: editorial, cultural, and acoustic (Pachet, 2011; Song, Dixon, & Pearce, 2012). Editorial metadata is the type of data provided by music editors, such as name of the artists, name of the composer, title of the musical work ('track title'), music genre, etc. Such editorial metadata is usually provided by those who submit the music item to the system. Cultural metadata is the result of analysis of data connected to the music item over the Internet. It discovers the associations, emerging patterns, similarities to other musical works based on the data from public sources. Acoustic metadata describes the musical work itself, including its qualities, such as beat, instruments involved, tempo, pitch, mood, etc. It does not require any other data than those related to the musical work itself (Song, Dixon, & Pearce, 2012).

7.3 User-Item Matching

Music recommendations rely on mechanisms, matching users and music items. To provide understanding of such matching mechanisms, we present an overview of the most popular techniques employed.

Metadata retrieval methods are used to retrieve music items that match input from the user, such as artist's name, title of a musical work, etc. This technique implies that the users already know data about the musical work they would like to listen to (Song, Dixon, & Pearce, 2012).

Collaborative filtering (CF) offers listeners new music (in the sense of "previously unknown to the listener") based on the listeners' past evaluations (Uitdenbogerd & Van Shyndel, 2002). There are three approaches: (i) CF determines the "nearest neighbour" user group that share similar tastes. The MRS then suggests items that are typical for this group (memory-based CF); or (ii) the MRS applies a mathematical procedure to suggest – based on the user's previous ratings to music items – new music items, previously unknown to the respective user (model-based CF) (Adomavicius & Tuzhilin, 2005); or (iii) the MRS combines both approaches to a so-called "hybrid CF" (Song, Dixon, & Pearce, 2012; Wang, de Vries, & Reinders, 2006).

Content-based filtering uses characteristics of a musical work (in the machine learning domain also referred to as "features") to determine similarities between items and derives predictions thereupon (Aucouturier & Pachet, 2002; Li et al., 2004). This way an MRS suggests music items to a user that are similar to those he or she has already listened to (Song, Dixon, & Pearce, 2012; Uitdenbogerd & Van Shyndel, 2002). Since the analysis is based on the qualities of music itself, content-based filtering does not require human input to operate.

Demographic filtering techniques create music suggestions based on a user's personal data (e.g., gender, age). Such filtering techniques divide users into groups based on their

personal data and provide music items that match a “typical” user of the respective group (Celma, 2008). This technique usually supplements other filtering techniques such as collaborative or content filtering (Song, Dixon, & Pearce, 2012; Uitdenbogerd & Van Shyndel, 2002).

Context-based modeling uses context (e.g., cultural metadata) of music items to come up with suggestions for its MRS’ users. This technique uses open data available on the Internet, such as music reviews, comments, ratings, friends’ lists, etc. (Lamere, 2004). Note, while the terms “context” and “cultural data” are established within a specific meaning in the MRS community (e.g., Schedl, 2013), these terms may be misleading as related communities use these terms with distinct meanings (e.g., for “context” in the context-aware computing community see Bauer & Novotny, 2017, to appear; Dey & Abowd, 2000).

Emotion-based modeling creates music recommendations on the basis of the emotions the music item is associated with (Yang & Chen, 2011). This modeling technique provides an emotional grid where users may define a mood and the MRS suggests corresponding music items. Advanced systems analyse musical features of the musical work and associate them with particular emotions.

Finally, hybrid methods are the combination of two or more techniques. The goal is to create better predictions than any technique would supply on its own, while avoiding their limitations and problems (Celma, 2008).

8 Impact of Music Recommender Systems on Non-Superstar Artists

This section focuses on the position of non-superstar artists in MRS. The information analysed provides both theoretical hypothesis and empirical research on the topic. We tried to estimate the effect that the techniques employed in the user-item matching process (cf. Section 2) have on non-superstar artists; our discussion focusses on the techniques that actually do have an impact on them.

Overall, current MRS have some deficiencies that affect the position of non-superstar artists in a negative way. While some problems originate from flaws in system design, sometimes the reasons for these problems are of different nature, mostly inherent to the employed techniques in the user-item matching process (Levy & Bosteels, 2010; Song, Dixon, & Pearce, 2012) (cf. Section 3.1.) In Section 3.2, we outline the positive effects of MRS for the position of non-superstar artists.

8.1 Popularity Bias

One of the most problematic issues that affect the position of non-superstar artists is the so-called popularity bias. In general, the popularity bias phenomenon suggests that over time the most popular music items tend to get more and more attention, while music items in the long tail get less and less attention. In particular, popularity bias is a significant problem when employing CF or context-based filtering due to the nature of the integrated algorithms (Levy & Bosteels, 2010; Song, Dixon, & Pearce, 2012). As concerns MRS, this phenomenon manifests in several ways.

For instance, CF uses listeners' ratings to create recommendations. This implies that popular music items receive generally more ratings than items of the long tail. This, in turn, entails that an MRS recommends popular items (that have more ratings) more frequently than less frequently rated items. This, however, reinforces the popularity of popular items and, thus, also increases their suggestion rates. As a result, items in the long tail receive less and less ratings, and so the system recommends them less frequently (Song, Dixon, & Pearce, 2012). For example, Fleder and Hosanagar (2007) could show this effect in a simulation study. They simulated an MRS based on CF, where music items were recommended based on the results of previous recommendations. Across several different user groups, the overall diversity of consumption by the end of the simulation was decreasing. In other words, the MRS was giving preference to more popular items over time.

In a similar way, context-based filtering uses data available about a musical works to derive recommendations. Since popular items are generally better promoted on media and are mentioned in more online sources, overall more information is available about those items compared to items of non-superstar artists (Song, Dixon, & Pearce, 2012). As a result, an MRS employing context-based filtering suggests popular and widely discussed items more frequently than items with less popularity; and this gap grows over time.

8.2 The Cold Start Problem

Closely related to the popularity bias is the so-called cold start problem, which refers to the difficulty to get recognition in an early stage when a new user or new item enters a MRS – due to the lack of data related to the user or item (Song, Dixon, & Pearce, 2012). When a listener just starts to use an MRS and has not (yet) submitted much information about herself or her preferences, etc. (e.g., ratings, clicks, etc.), the MRS will only provide her with general recommendations (Celma, 2008). Similarly, when new music items are introduced to a system, they do not make it into the recommendation results because there is not enough data available about these items (cold start), which would trigger the MRS suggestion (Celma, 2008; Song, Dixon, & Pearce, 2012; Uitdenbogerd & Van Shyndel, 2002). In addition, artists new to the market do not only have merely new music items in their portfolio, there is also not much data available about them as artists, entailed with less frequent discussion, promotion, etc. As a result, the chance that new artists' items are

recommended by an MRS are even less likely than that for new items of established artists (Celma, 2008; Song, Dixon, & Pearce, 2012).

8.3 Superstar Economy Speculations

In addition to research on the effects of and consequences inherent in the techniques an MRS employs, some sources assume that MRS are biased towards popular tracks not only due to their design and the algorithms employed, but on purpose as hit items generate larger profits than items of non-superstars (due to, e.g., economies of scale).

For instance, a marketing report by Media Insights & Decisions in Action Consulting (Mulligan, 2013) concludes that the recording music industry is not at all oriented at long-tail items; according to this source, one of the main reasons for it is that MRS do not only offer popularity-biased recommendations, but also that music platforms get polluted with musical works that are created in “bad” quality (not so pleasant to the listener) on purpose, with the aim to enhance the positions of the already popular music items (hits). Such “bad” musical works sound similar to the bestselling songs, but in comparison the listener would still prefer the more popular, “better” song (Mulligan, 2013). As a result, the sum of sales for hit songs is higher than that for non-hits, so music platforms are more motivated to sell more of popular music items (Guadamuz, 2015). This opinion is supported by findings of research investigating users’ music preferences (e.g., Farrahi et al. (2014) show that users who prefer mainstream music are in general easier to satisfy with an MRS).

In contrast, for instance, Levy and Bosteels (2010) investigated whether the MRS employed by the Last.fm platform is indeed biased towards more popular items, as suggested in earlier literature. They compared three different data sets: (i) the one of Last.fm Recommendation Radio, which recommends specific music to specific users based on their (user) data, (ii) the Last.fm Radio data set, which plays music recommended to Last.fm users in general, and (iii) and a data set of the Last.fm music streaming services as a whole, which summarizes the information about what users are listening to while using Last.fm. The findings suggest that Last.fm, as one of the largest worldwide MRS, is biased towards non-hits rather than towards hits in comparison to overall user listening experience, and this bias is stronger for Last.fm Recommendation Radio. Based on these results, the authors conclude that real-world data can significantly differ from simulations and also state that not all MRS seem to be biased towards more popular artists.

8.4 Impacts of Music Recommender Systems

While the topic of popularity bias and the recommender system inadequacies seems to be one of the most broadly studied topics with regard to MRS research, it seems that research has been limited on the existence and the reasons of these phenomena. Yet, exploring the impact of these phenomena on different artist groups (e.g., superstars versus non-superstars) or differentiating in more detail within an artist group (e.g., artists from different genres, countries, age groups, etc.) has not (yet) been investigated.

For instance, as mentioned in a Billboard article (Maddux, 2014), researchers and media tend to focus on disadvantages and flaws of MRS' performances, while neglecting the fact that the existence of the discussed phenomena may be a big advantage for a privileged group of artists. For example, in the "old" music business, when music was either distributed on physical media (e.g., vinyl, CDs) and/or promoted through live shows, it was tremendously challenging for newcomers to the industry to get recognition, if their music did not "score" to become an immediate hit (Anderson, 2004). Now, newcomers ("no names") have the chance to slowly make their way up in industry by experimenting with the recommendation mechanisms and promoting their works accordingly (Maddux, 2014). The shift from the short-tail to the long-tail model might not be as significant as in other entertainment industries such as films as books, but it is still present and it continues growing (Guadamuz, 2015). This view is supported by the case we investigated and is presented in the following Section 4.

9 Insights from a Real-world Case

To gain some insights on how MRS impact non-superstar artists from their point of view, we drew from the experience of an aspiring, non-superstar music band using the Internet as the main tool to promote their music.

9.1 Approach

Several criteria motivated the selection of an interviewee to gain hands-on insights on challenges and opportunities for non-superstar artists: recent release of an album, experience with MRS, use of Internet as a main promotion tool, newcomer on the market, limited information about the artists (yet) available on the Internet, and professional attitude and aspiration (no "just for hobby" band).

Based on these criteria, we selected a Ukrainian oriental metal band, founded in July 2011 under the name "Parallax", renamed in 2015 to "IGNEA". Their first work "Alga" was released in 2015, whereas they released their first full-length album "The Sign of Faith" in 2017 (cf. <http://ignea.band>).

This band was selected to provide insights on the topic of MRS from the artists' point of view because since their debut in 2011 they mostly use Internet to promote their work

and have experience with MRS as a non-superstar artist. It matches the definitions of the long-tail artist in music industry, since it works in a highly specific, niche genre, which is very different from popular music. As one of the founders of the band, vocalist and songwriter, Olga was a highly suitable candidate to provide information regarding IGNEA's activities.

We conducted the interview via Skype using a semi-structured approach (i.e., relevant questions prepared beforehand, but preserving the flexibility to stray away from the intended plan, if the artist provided interesting thoughts on the topic). The interview took 17 minutes (full audio recording is available). We applied content analysis (Krippendorff, 2013) for text reduction, analysis, and interpretation.

9.2 Findings

According to the interview, the band promotes their music on the majority of well-known music platforms, such as Spotify, YouTube, iTunes, and others. The music items are submitted to the platforms through a third-party aggregator. Using such a service, the artist may – aside from the name of the artist and the titles of the music items – provide several tags associated with their music items (typically up to three), such as genre, beat, and other similar characteristics describing the music items. The strategic steps on the artist's side usually consist of the timing for the releases and coming up with tags that would attract the attention of their potential audience.

The interview indicates that the band's overall experience with them as a non-superstar artists is very positive. For instances, about 80% of their listeners and purchasers discovered the band through MRS recommendations. Furthermore, achieving success on the platforms (through MRS) has led to mentions on the media. Overall, our interviewee pointed out that MRS combined with the power of Internet had helped the band to generate international audience instead of regional listeners; currently the majority of their listeners is located in the United States.

The interviewee expressed her opinion that she thinks many artists fail on platforms with MRS due to the lack of knowledge and/or effort that the artists put into managing their activities on such platforms, trying to exploit MRS for their own ends. She emphasized the importance of studying and understanding how such systems work, and pointed out the lack of knowledge that artists seem to have about the tools available. She said that those might not be aware of the tools and possibilities and do not sufficiently search for their opportunities. The observation of the lack of managerial skills is backed up by research findings (e.g., Bauer & Strauss, 2015; Bauer, Viola, & Strauss, 2011)). Behaviour on the market, partly resulting from such an educational deficit, may lead to (self-)destruction of the economical basis of aspiring artists (Bauer & Strauss, 2017, to appear). She believes that a good artist can reach success with the help of MRS. She stated that her band will continue using MRS to promote their music in the future.

Among the disadvantages, she complained of the lack of flexibility for submitting information that artists could easily provide to specify and characterise their own music, such as the limited amount of tags they can include when submitting a music item. Another drawback is that most platforms keep confidential what kind of data is used in the employed MRS, and in what way it is used by their algorithms. Furthermore, the artists get access to only very general and aggregated information such as number of plays/purchases and country of origin of the users; accordingly, it is difficult to adjust their strategies efficiently to use the MRS for their own benefit.

10 Conclusion

This paper provides insights into mechanisms of current MRS and explored the challenges and benefits that non-superstar artists are confronted with on platforms employing MRS. While research on MRS tends to focus on technical issues and/or explores the field from a rather technical perspective, this work dedicates to the impact on and value generation for the group of artists that provide the vast majority of music items available on platforms using MRS (i.e., non-superstar artists) – a topic that had been neglected so far. We outline several techniques how MRS generate recommendations and discuss their pros and cons. We elaborate the non-superstar artist's perspective on MRS and present considerations from the point of view of a non-superstar artist. In particular, we explored the question how the professional advancement of non-superstar artists is affected by MRS.

It may be concluded from literature that some techniques of MRS do have a negative impact for non-superstar artists as these are biased towards more popular music and fall short in overcoming the cold start problem; yet, some MRS do support the aspiring non-superstar artist. Based on literature and our case elaboration it may further be concluded that MRS provide opportunities for aspiring artists to exploit MRS for their own benefits, as MRS provide a comparatively inexpensive tool for artists to strategically promote their music in a self-determined manner. Further research on the impact of Internet technologies on non-superstar artists may compare the influence, value, and impact of MRS with other means available to this artist group to promote their music. Future work could focus on MRS from the artists' perspective; with regard to the findings from the interview in Section 4, we believe that the results of such studies could reveal interesting insights and may constitute a valuable contribution to MRS research.

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POLO: A Framework for Short-term Studies Abroad to Enhance Critical Thinking Amongst Management Students

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Abstract This article presents the preliminary results of an ongoing study to reduce the cost of short-term studies abroad, which are aimed at increasing critical thinking of management students. We propose to combine the notions of apprenticeship, massive open online courses, pedagogy portal and paper template for reflective practice over the cultural adjustment abroad. The resulting framework allows performing four tasks described by the acronym POLO: Pre-departure sessions to prepare students, Observation activities during the trip to enhance their critical thinking, Learning activities done by virtual teams across two universities and Ontological changes to adapt to a new cultural environment. As an instantiation of our model, we briefly describe a course of digital marketing that has been implemented in the last three years, and we share some relevant insights which complement the existing body of knowledge.

Keywords: • framework • short-term studies • management students • studies abroad • POLO •

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1 Introduction

Some 720 years ago, a book appeared in Europe, marvelling the travel in Asia that Marco Polo started when he was seventeen and that ended when he came back to Venice 24 years later. Although the book contains omissions and exaggerations, it describes how a merchant perceived the wealth and great size of Asian cities and it soon gained popularity in Europe, while inspiring other travellers to travel even further, one of which was Christopher Columbus.

The purpose of this article is to describe an ongoing project for teaching professors to design a training program meant to transform any management students, the same way a long journey to Asia transformed a simple merchant into Marco Polo.

We define a study exchange program as a program in which students from a university study abroad at one of their institution's partner institutions. Since such programs might be hard to organize from an administrative point of view, this article focuses on short-term study abroad, which lasts less than three months and exposes students to an intensive program that increases their understanding of other cultures, communities, and languages. Short-term, non-language-based study abroad programs can have a positive impact on intercultural sensitivity (Anderson, Lawton, Rexeisen, & Hubbard, 2006). Moreover, previous studies have already shown no statistically significant differences between the semester-long group and the short-term group (Kehl & Morris, 2008).

A recent stream of literature has studied how short-term study abroad enhance critical thinking among students (Cai & Sankaran, 2015), which is defined here as the application of focused reflection and reasoned thought, and how to prepare the pre-departure sessions to properly prepare the students (Mantha, 2016). Although the positive effects of a short-term study abroad have been discussed in previous studies, a major barrier for teaching professors is the cost to implement it. In this study, we wish to find a way to lower three components of such cost: (a) the effort required to obtain the economic resources needed to do the trip, (b) the effort required to prepare the students and (c) the effort required to assess the acquisition of relevant competences.

In this paper we seek for a set of guidelines that reduce the effort required to organize a short-term study abroad for a university course. Such goal seems to be best addressed by a design science methodology, which seeks for utility rather than truth (Hevner, March, Park, & Ram, 2004) and will be instrumental to develop a framework of guidelines for teaching professors. Therefore, our research question is: how to reduce the cost of a short-term study abroad aimed at increasing the critical thinking of management students?

The rest of the paper proceeds as it follows. Section 2 briefly assesses the state of the art with respect to relevant concepts needed to answer our research question. Section 3 describes our methodology and the proposed solution. Section 4 illustrates the

preliminary results obtained. Section 5 concludes the paper by discussing its limitations and by highlighting possible directions for further investigation.

2 Literature review

In this section we introduce three concepts to address our research question: (a) apprenticeship as a way to gather resources for the trip, (b) massive online open course to standardize the content used to prepare the students, (c) information technology to collect information during the trip.

(Chieffo & Griffiths, 2003)) point out that the majority of study abroad programs are now short-term and faculty-led, but it does not specifically address the issue of effort required for financing. In this paper, we suggest establishing partnerships with firms and have students do apprenticeship in the firms during the course, in exchange of financial supports for the short term study abroad. This approach is inspired by the Finnish model of education to teach entrepreneurship, the so-called “Team Academy” approach (Leinonen, Partanen, Palviainen, & Gates, 2004) that has already influenced the way management courses are taught (Tosey, Dhaliwal, & Hassinen, 2015). Apprenticeship can be defined as a system of training a new generation of practitioners of a profession with on-the-job training and some accompanying study (classroom work and reading). With respect to internship, apprenticeship is more structured and it requires a close collaboration between the firm and teaching professors.

If one assumes that management students are apprentices, who do a project during a semester that includes a short-term study abroad, the pre-departure sessions meant to enable students to perform critical thinking during the period abroad needs to be consequently adapted. Indeed, existing literature has already offered a set of guidelines to increase the critical thinking of students by means of three sessions that address three relevant questions: (a) Session 1: Choosing My Adventures (b) Session 2: What’s My Attitude? and (c) Session 3: Building My Skills. Nonetheless, the useful material offered by the authors need to be complemented with other resources that help students solving the problem of the firm. In this sense, one way to train students is to use a massive open online course (hereinafter referred as MOOC), which can be defined as an online course aimed at unlimited participation and open access via the web (Breslow et al., 2013). Online companies, such as Coursera or edX, offer courses from top universities that include videos and tests to assess knowledge acquisition. Although the real value of MOOCs is currently debated (Shea, 2015), xMOOC are a useful approach to assure that the training of students is in line with what is currently taught in other universities, where “x” stands for “extended” meaning that the MOOC complements a course done in class.

Finally, it should be taken into account that, during a short-term study abroad, students do not have constant access to a personal computer or to internet access. Therefore, it would be advisable to combine (a) online tools that allows students from different classes to work together and (b) paper templates to carry on and to fill in during the trip to assist

the students in their reflective practice. An example of the former is the project “Portal Pedagogy” (Monk, McDonald, Pasfield-Neofitou, & Lindgren, 2015) that connects geographically distant students through technology and curriculum to create a student-centred community of inquiry neither bound by disciplines nor countries. An example of the latter are checklists to assess the different phases of the U-curve adjustment theory (Lysgaard, 1955), which describes how students pass through four stages of adjustment: honeymoon stage, culture shock stage, adjustment stage and mastery stage.

3 Methodology and theoretical model

In this section we briefly illustrate (a) how we followed the guidelines of design research and (b) the four components of our framework.

3.1 Design research

Since we did not find a theory to design a short-term study abroad with limited resources, we apply design science, which addresses so-called wicked problems, defined as difficult or impossible to solve because of incomplete, contradictory, and changing requirements that are often difficult to recognize (Rittel & Webber, 1973). We follow the six steps of (Peffer, Tuunanen, Rothenberger, & Chatterjee, 2007) to perform design research.

1. Identify problem and motivate: the overall need of international experience was brought by companies, who hire our students after the completion of their university training. The specific need of reducing the effort required to include this activity in the course was due to the limited resources available at the university.
2. Define objectives of the solution: we looked for an existing solution to adapt our course of digital marketing. Once we found the model of (Cai & Sankaran, 2015), we tried to extend it in order to allow quantitative analyses and benchmarks among groups of students.
3. Design and development: we developed the course iteratively over three years. Each year, we improved one of the three cost components. The first year we introduced the notion of apprenticeship to lower the cost of financing. The second year we complemented our courses with MOOCs and we started measuring skills acquisition with external surveys. The third year we developed a travel guide with templates to fill after each visit.
4. Demonstration: each year, we tested the model by travelling with selected students of the course of digital marketing to the same location, in order to allow comparison between different years.
5. Evaluation: we assessed the effort required to organize the short-term study abroad, while measuring the satisfaction of students and companies.
6. Communication: We waited until the third iteration to communicate the results of our model, due to the complexity of the task at hand.

3.2 Our framework

The resulting model has four components that form the acronym POLO, two of which have been fully implemented for a course of digital marketing, and two of which will be implemented in the next iteration.

- a) Pre-departure sessions: We identified three main themes associated to the experience that students would have done abroad, and that could be improved by digital marketing techniques: tourism, education and strategy consulting for firms. According to (Cai & Sankaran, 2015), there are three components of the theme-based interdisciplinary approach, which we adapted to our situation: (a) Great questions: in order to perform each experience, students had to combine existing notions of information technology, strategy, market analysis and service design. (b) Glocal awareness: during each experience, students had to report how they felt about being immerse in a foreign country and what changed with respect to the local context they were used to. (c) Global awareness: after each experience, students were asked to propose ways to translate the skills learnt in a global context into the ecosystem of the firm, they were working with. Moreover, we had to take into account the interaction between the students and the firm that financed their trip. Since we did not want to personally attend the meetings between the students and the firm, we decided to use a set of proxy measures. We used two MOOCs from Coursera and training material from Google and Facebook to prepare students to the topic of digital marketing. Students were asked to complete the course at home and to come to class prepared to discuss about how to implement the theory into their group project with the firm. Every month, the students had to complete a set of quiz to monitor their mastery of theoretical concepts. In order to measure retention of concepts, we submitted the same quiz more than once. Hence, the first month, students would have to do quiz 1; the second month, they would have to do quiz 1 and quiz 2; the third month, they would have to do quiz 1, quiz 2 and quiz 3, and so on. Only the first quiz led to a summative evaluation; the result of the other quizzes was known by the students but did not change the initial score. That way, we would monitor how many theoretical concepts were put into practice within each group, and to perform risk analysis at the group level. One month before the trip, the firm had to do an intermediary evaluation, and we checked if there were correlations between our risk analyses and the feedback of the firms.
- b) Observation while being abroad: According to (Cai & Sankaran, 2015), there are three components of the cultural immersion (site visits, activities and assignments):
 - a. Experience: whenever possible, students were advised to observe how locals were behaving with respect to each theme previously defined.

- b. Reflection: at the end of each day, students were brought to traditional monuments and restaurants to familiarize with the underlying culture of the city.
- c. Application: students had the opportunity to follow university courses and presentations done by international firms on the same topic.

In order to assess the increase in the critical thinking of the students, a set of templates to fill were given. The templates to fill in had the same structure for every theme: (1) analysis of the touchpoints between the student and the service, (b) link between the touchpoints and the concepts of digital marketing learnt in class, (c) observation of existing digital solutions used in the context and difference between theory and practice (d) suggestions for improvement and explications of implementation.

- c) Learning with another class: This component of the framework is currently under development and it has not been tested yet. In its final stage of development, we envisage to create virtual teams composed by students from two universities in two different countries, which will have to perform a joint task, i.e. to attend the Google Online Marketing Challenge. A groupware with project management functionalities, such as LiquidPlanner, will allow students from the two universities to talk before meeting during the short-term study abroad. Then, students will continue working together from two separate countries.
- d) Ontological changes: This component of the framework is currently under development and it has not been tested yet. Previous research has already shown that the different stages of the U-curve adjustment theory can be shortened by (a) performing pre-departure exposure to the host culture, (b) teaching techniques of anticipatory adjustments to the host culture and (c) increasing the time spent with host country nationals (Black & Mendenhall, 1991). Accordingly, teaching professors could link the quantitative results obtained during the pre-departure sessions and the data collected during the trip, in order to monitor if the honeymoon and the culture shock stages last too long, and act accordingly. For sake of simplicity, we list here only two propositions derived from the U-curve adjustment theory: (P1) students who spent little time to attend to models, will report the lowest levels of perceived dissimilarity between the approach of the host country nationals and themselves at the beginning of the trip, and (P2) students that have written more of new and appropriate behavior at the beginning of the trip will receive a greater positive reinforcement and will adjust quicker to the new culture.

4 Preliminary test results

In this section we illustrate the results of the most recent test the first two components of our model, which was used with a class of 35 students of the course of digital marketing. At the beginning of the academic year, students were split into eight groups depending

on their interests and skills. The goal of each group project with the firm was the same: to design and implement a digital strategy for the firm. Nonetheless, each group project slightly changed over time, depending on the stage of digital maturity of the firm or the resources available. Each group received theoretical classes once a week and had to meet the company once a month, as part of their apprenticeship. In the middle of the academic year, a short-term study abroad was meant to let students acquire international awareness, by meeting multinational firms and by attending classes in another university. Accordingly, the city of Dublin was chosen, since it hosts the headquarters for the Europe – Middle East – Africa (EMEA) zone of Facebook (marketing), LinkedIn and Twitter, as well as hosting the headquarters of Google Ireland, Microsoft Ireland and Amazon Ireland.

In the following paragraphs, we illustrate how we monitored the interactions (a) between the students and the firm during the pre-departure sessions and (b) between the students and their new environment during the observation phase abroad.

4.1 Assessment of knowledge acquisition

Since we did not want to personally attend the meetings between the students and the firm, we decided to use a set of proxy measures. Figure 1 illustrates how we monitored the firms. Each student did the quiz 01 three times over the course of one semester. The quiz was composed of 40 questions directly taken from Coursera, and its score ranged from 0/10 to 10/10. After each quiz, we gathered all results of all students and then we extracted the median, the maximum and the minimum for each group. Finally, we assigned the groups to different risk clusters, depending on their maximum and minimum.

Table 1: Classification criteria to classify groups into risk clusters

Team Leader(s)	Sluggoer(s)	Cluster
0 (Max<7/10)	0 (Min<5/10)	Panic
0	1 (Min<7/10)	Confusion
0	2 (Min>7/10)	Theory and no practice
1 (Max<9/10)	0	Tired leader
1	1	Need support
1	2	Committed but leaderless
2 (Max>9/10)	0	Free riders
2	1	Some free riders
2	2	Good leadership

Table 1 shows the classification that we used to monitor the groups. If the maximum score was less than 7/10 we assumed that no one was in charge of the team and we assigned a 0 in the first column. If there was a minimum score below 5/10 we assumed that there

was at least one slugger and we assigned a 0 in the second column. Usually, teams started all at the best position during quiz 1 (=Good Leadership), where most of the students had 10/10. Nonetheless, over time students started forgetting what was not put into practice.

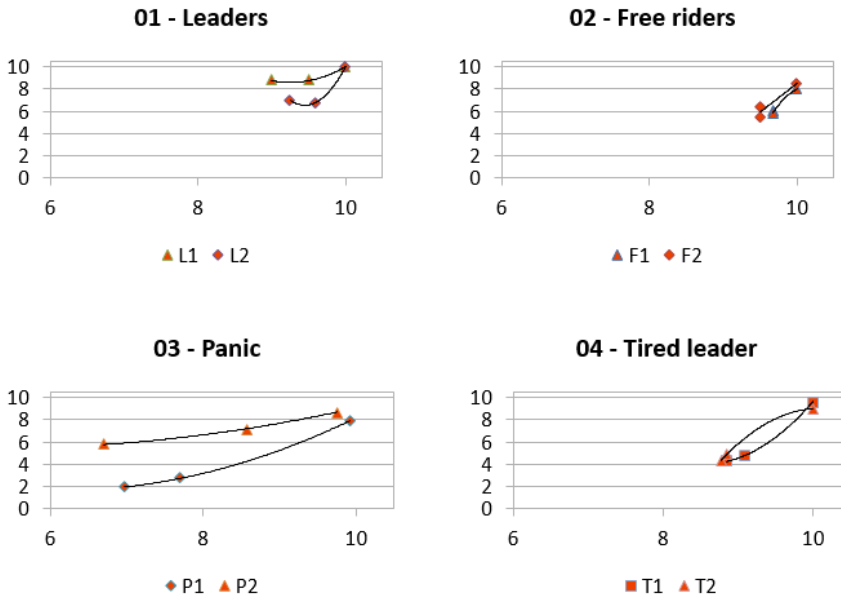


Figure 1: Different trajectories of the eight groups

Figure 1 shows that teams L1 and L2 managed to reduce the distance between the maximum score and the minimum score of the third quiz. Hence, one can assume that they managed to involve the potential sluggers in the team. Instead, teams F1 and F2 did not correct the distance between max and min but they managed to keep such distance steady between the quiz 2 and the quiz 3. Team P1 and P2 could not control the amount of free riding in the team and eventually no one took the leadership. Interestingly enough, these two teams did not have problems with the firm. Indeed, by discussing with the firms we realized that the company took the role of the leader and the students decided to follow. Finally, teams T1 and T2 increased the amount of free riding in the team over time and lost the degree of leadership. These teams had issues in their mid-term evaluation, because the two firms did not take the lead.

4.2 Preparation of the theme-based interdisciplinary approach and cultural immersion

Table 2 illustrates an example of development of the theme “Strategy consulting”. Students received a printed book with templates to complete, such as the one shown in the example. On day 1, students went to an Irish university and conducted a case study, under the supervision of a teaching professor in charge of the course of digital marketing

at the hosting university. On day 2, students went to visit the company analysed and were asked to perform reflective tasks to better understand the difference between theory and practice.

Table 2: Theme development across day 1 (case study) and day 2 (visit at the firm)

Case Study Guinness

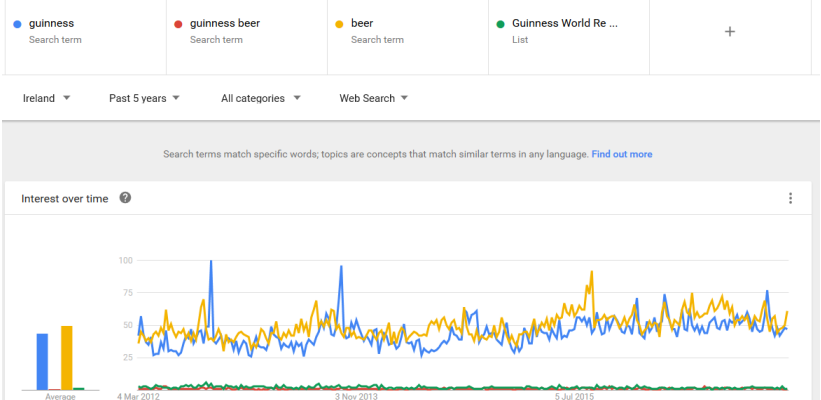
Dates : Day 01 (15 :00 – 16:00)

Part 1: Digital strategy of Guinness
Analyze the amount of times the word “Guinness” is searched on Google Ireland, with respect to the word “beer” and “World record”.
(<https://trends.google.com/trends/explore?geo=IE&q=guinness.guinness%20beer.beer,%2Fm%2F0pmx5>)

Part 2: Marketing strategy of Guinness Storehouse
Read the HBR article “The Brand Benefits of Places Like the Guinness Storehouse” (<https://hbr.org/2015/10/the-brand-benefits-of-places-like-the-guinness-storehouse>). Then, link the keywords used by the reviews on Tripadvisor to the seven principles.

Part 3: Your Google Ads to promote the website of Guinness storehouse
Design a Google Ad to increase by 1000 the number of tickets sold online to tourists in the month of April. To estimate the budget, assume that the rate of ticket sold is 1% of the people clicking on the ad. To comply with regulations on alcohol advertising, make sure you do not sell alcohol to teenagers. Finally, assume that every ticket sold online saves 3 CHF to Guinness with respect to a ticket sold on the building.

Part 1.1 : Digital strategy of Guinness



Why is the word «Guinness » searched more than the word « beer » ? (Hint: look at the related queries)

.....

....

Think about an example of how social marketing online allows Guinness to promote its brand, while respecting regulations on advertising of alcoholic beverages

.....

....

Part 1.2 : Marketing @ Guinness Storehouse

Read reviews that mention:

Search reviews 

- All reviews
- gravity bar
- free pint
- top floor
- pour your own
- self guided tour
- brewing process
- perfect pint
- black stuff
- learn how
- brewery tour
- degree view of dublin
- connoisseur experience
- tasting room
- learning how
- own pace
- gift shop
- visiting dublin
- interesting tour
- certificate
- advertising

	Principle	Keywords	Comments
1			
2			
3			
4			
5			
6			
7			

Part 1.3 : Google Ads

Goal : 1000 tickets sold on the website of Guinness storehouse

(<https://www.guinness-storehouse.com/en/tickets>)

Time : From March, the 1st to March, the 31st

Target 01: Adults 18-40, living in your country

Target 02: Teenager 12-18, living in your country

You can use the most frequent words used in the reviews of TripAdvisor to define your keywords. Keywords:

- 1
- 2
- 3

Once you have defined your keywords, estimates the cost per click. Let assume here that the cost is 0.03 CHF. Indicate below your estimate of the daily budget and the return on investment.

Daily Budget:

.....
.....

ROI = (gain from investment – cost of investment) / cost of investment

.....
.....

Guinness Storehouse

Dates Day 2 (9 :30 – 11 :30)

Planning

- **09 :15 – 09 :30** : Meeting at the entrance
- **09 :45 – 10 :45** : Exercise
- **11 :15 – 11 :30** : Debriefing and beer at 7th floor

Once the trip was concluded, we collected all printed book to assess their contents. As it turned out, the classification done at the pre-departure sessions, which was shown in Table 1, allowed to partially predicting the trajectory of the groups. In order to assign groups to cluster, we checked if the templates in their printed book were completed (=2) or partially completed (=1), and if the answers of the participants were similar (=0) or somehow different (=1). Table 3 shows that most groups did not change their internal

dynamics, with the exception of the groups with the free riders, where the leader became tired (groups F1 and F2), and one group in “Panic” state, which managed to rebound during the trip abroad. This confirms our first proposition (P1) concerning the importance of the pre-departure stage. Since one group has improved its relative performance during the trip, we need additional information to confirm our proposition concerning the importance of positive reinforcement to teams, which properly prepared before the trip and acquired new and appropriate behaviors in little time.

Table 3: Score before and after the short-term study abroad

Group	Leader	Sluggler	Cluster Before	Completed	Similarity	Cluster After
F1	2	0	Free riders	1	0	<i>Tired leader</i>
F2	2	0	Free riders	1	0	<i>Tired leader</i>
P1	0	0	Panic	0	0	Panic
P2	0	0	Panic	2	1	<i>Some free riders</i>
T1	1	0	Tired leader	1	0	Tired leader
T2	1	0	Tired leader	1	0	Tired leader
L1	2	2	Leader	2	2	Leader
L2	2	1	Some free riders			

5 Discussions and conclusions

This article presents the preliminary results of an ongoing study to reduce the cost of a short-term study abroad aimed at increasing the critical thinking of management students and to transform each of them into the Marco Polo of the 21st century. We start by proposing to start by a project that implies apprenticeship in firms and that uses the time spent abroad in order to solve a problem of a company, which could cover the travel expenses in return. Accordingly, we have adapted existing templates for pre-departure sessions of (Mantha, 2016) to include the notions required to solve the problem of the firm, and we have devised a way to use MOOCs and standardized tests to monitor the work of the students. Finally, we have extended the framework of (Cai & Sankaran, 2015) to have the summative and formative evaluation under a quantitative form, to allow benchmarks among students.

At its current stage, this study has two major limitations: (1) the first one concerns the two missing dimensions of the POLO framework, which makes it hard to assess its validity as an overall; (2) the second shortcoming concerns the way reflective exercises are constrained by the templates to allow simple benchmarking. Nonetheless, we believe that our preliminary results already offers two interesting contributions to previous knowledge: (a) if students work in teams, the team dimensions should be taken into account and (b) if students work with a sponsor, the dynamic with the firm should be monitored to avoid the situation “tired leader”.

In the future, we intend to develop the two last components of our framework and to test it quantitatively on a larger scale. In the beginning, we shall limit our observation to two classes in two countries, in order to better control for cultural effects. Indeed, we intend to assess an additional proposition derived from Black & Mendenhall (1991), concerning the sources of anticipatory adjustment, such as training or previous international experience, that increase attention and retention processes will in turn speed up the learning process of some students.

In order to properly assess the ontological change, we also intend to try a version of the printed book with templates for students, which constrain less their possibility to express themselves.

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A Co-Creation Based Model For Engaging Citizen Open Data Use

COLIN CALLINAN, MURRAY SCOTT, EOIN WHELAN & ADEGBOYEGA OJO

Abstract Open data is a somewhat new phenomenon that is increasingly attracting attention from researchers in the academic and practitioner fields. The transformative potential of open data is being examined from various directions and in an interdisciplinary fashion. While major attention has been paid to technical aspects of open data there remains a paucity of research into usage and theoretical contributions. This study aims to examine the factors that influence citizens use of open data. In so doing, we attempt to address the paucity of theory building around open data. We further highlight the potential role that the prominent factors in co-creation can play in engaging the citizen in open data use.

Keywords: • Open data • Co-Creation • Openness • Participation • Deliberative citizenship •

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1 Introduction

Open data is an increasingly topical concept which is rapidly growing in popularity amongst governmental organisations, researchers, the business community and other stakeholders. Open data has been defined as 'a “philosophy” or “strategy” that encourages mostly public organizations to release objective, factual, and nonperson-specific data that are generated or collected through the delivery of public services, to anyone, with a possibility of further operation and integration, without any copyright restrictions' (Hossain et al., 2016). Open data can be viewed as a key signifier of the evolving nature of the relationship between government and the citizen as the use of Information Technologies in government holds the promise of enhanced democracy and increasingly engaged citizen participation.

Led by former US president Barack Obama's announcement in 2009 that his government would embark upon a transparency strategy that would see much greater levels of openness in government, many governments around the world have since followed suit with increased emphasis on open data as a key component (Huijboom and Van den Broek, 2011). The potential benefits accrued are manifold. These have been categorised by Janssen et al. (2012) as firstly, political and social e.g. more transparency, creation of trust in government, more participation and self-empowerment of citizens etc. Secondly, economic, e.g. economic growth, stimulation of innovation, development of new products and services etc. Thirdly, operational and technical, e.g. counteracting cost associated with recollection and unnecessary duplication of data, optimisation of the administration process, improvement of public policies etc.

With the increased availability of Open Data, intense pressure is being brought to bear on different public organisations to release government produced data. There are myriad reasons for this including public spending cost reduction, increased returns on public investment, wealth generation, service delivery and innovation (Janssen et al., 2012, Zuiderwijk et al., 2015). The somewhat romantic view is that this will increase transparency and democratic accountability, create trust in government and self-empower citizens (Janssen et al., 2012). While policy-makers appear to believe that open data will be taken up and used by the public resulting in copious benefits, (Zuiderwijk et al., 2015), this belies the fact that the focus of interest in the literature has been on technical and operationalisation issues and scant attention has been paid to usage, theoretical contributions and the role of the citizen in this process. This research will utilise the theory of value co-creation (Galvagno and Dalli, 2014, Prahalad and Ramaswamy, 2000, Prahalad and Ramaswamy, 2004, Voorberg et al., 2015), and develop a model that explains the factors that influence citizen engagement in the co-creation process. We validate and expand on previous work by Voorberg et al. (2015), to create a theoretical model which we hope to validate through future research.

2 Background & Model Development

In this section, we examine three relevant areas of literature. First, we discuss the previous work on open data, the definition of the concept and its precursors. Next, we discuss the evolving role of the citizen while paying special attention to the move from consultative to a more deliberative citizenship. Finally, we examine the theory of Co-Creation as a useful analytical tool that can be used to foster greater involvement of the citizen in the workings of state.

2.1 Open Data

Bertot et al. (2014) propose a holistic definition of open data which encompasses the theory that ‘certain kinds of data should exist beyond the limits of copyright, patents, censorship, or other parameters often placed around data. Data is disseminated openly so that it is freely available to use, republish, and transform into new products’. The majority of articles, both academic and practitioner focused, have failed to reach consensus or clarity on the exact definition of open data. The defining characteristics of Open Data comprise three essential traits that must feature in order to fulfil the philosophy set out by practitioners and academics. While some researchers have cited additional characteristics such as the necessity for data to be non-privacy restricted and non-confidential, (Janssen et al., 2012), as mentioned above, there is a lack of definitional consensus on these characteristics. To address this shortcoming, a summary of open data definitional characteristics drawn from the literature is illustrated below in Table 1.

Table 1: Open Data Definition Characteristics

Characteristic	Source
Produced with Public Money	Hossain et al., 2016, Weerakkody et al., 2016, Zuiderwijk et al., 2015, Bates, 2013, Janssen et al., 2012.
Available Without Restrictions on Usage or Distribution	Hossain et al., 2016, Attard et al., 2015, Bertot et al., 2014, Janssen et al., 2012, Shadbolt et al., 2012.
Published in a Reusable Format	Dawes et al., 2016, Hossain et al., 2016, Weerakkody et al., 2016, Huijboom and Van den Broek, 2011, Peled, 2011.

In the past, this data was preserved by governments for internal usage until the 1960’s when the freedom of information (FOI) campaign pushed for the public disclosure of government data (Sieber and Johnson, 2015). Currently, the movement for greater openness in government has led to an explosion of interest in the open data arena. A clear example is data.gov, one of the most popular portals for open data sets, lists 44 countrywide open data sites proving that the open data movement has spread internationally (Lourenco, 2015).

2.2 Repositioning The Role Of The Citizen

The movement towards openness in government with open data as a key component has the potential to forever alter the relationship between the state and the citizen. Largely, the participation mechanisms enacted over the last quarter of a century have been consultative in nature resulting in little influence over public policy (McLavery, 2011). These have taken the form of citizens' assemblies, referendums, citizen juries, public meetings and opinion polling (McLavery, 2011). These have been largely unsatisfactory in most cases and act as 'a supplement to traditional representative democracy, rather than an alternative to representative democracy' (McLavery, 2011, p. 415). In addition, Dryzek (2000, p. 1) has argued that since the 1990's, democratic theory has taken 'a strong deliberative turn. Increasingly, democratic legitimacy came to be seen in terms of the ability or opportunity to participate in effective deliberation on the part of those subject to collective decisions'. He further argues that democratisation takes place along three dimensions: franchise, scope and authenticity. He states that 'authenticity is the degree to which participation and control are substantive as opposed to symbolic' (Dryzek, 2000, p. 86). This search for "Dryzekian authenticity" has come about as a result of 'declines in traditional forms of participation associated with representative democracy' (McLavery, 2011, p. 415).

2.3 Co-Creation

Co-Creation as a concept has evolved continuously since its antecedents appeared in the form of co-production in the 1980's. In the sphere of public administration, the seminal papers produced, (Brudney and England, 1983, Parks et al., 1981, Sharp, 1980, Whitaker, 1980), added a solid foundation which was initially built on by Prahalad and Ramaswamy (2000, 2003, 2004).

There has been a great deal of discussion in the academic literature concerning the issue of definitional differences relating to co-production and co-creation (Grönroos and Voima, 2013, Leroy et al., 2013). Voorberg et al. (2015) found that when they compared the record definitions of co-production and co-creation, to a large degree, both terms were defined analogously. In addition, they concluded that co-creation and co-production have been used as interchangeable concepts while questioning the feasibility of conceptual clarity. Given the definitional murkiness of the co-creation concept and its interdisciplinary nature, this research will draw from Galvagno and Dalli (2014, p. 644) more broad definition of co-creation as a 'joint, collaborative, concurrent, peer-like process of producing new value, both materially and symbolically'.

2.4 Barriers To Open Data Use From The Citizen Perspective

In order to determine whether non-technical barriers exist to open data use, we reviewed the pertinent literature in the field. We found that there is a lack of articles that examine

barriers in a non-technical sense. The relevant articles that address the subject directly are examined below.

Ohemeng and Oforu-Adarkwa (2015) examined the Ghana Open Data Initiative (GODI) from a demand side perspective which was initiated in 2012 with the primary aims of administrative efficiency and economic development. They described the level of civil society involvement as ‘abysmal’ and one of the main non-technical challenges has been the involvement of citizens in the process. This is explained as a consequence of a skills deficit and a lack of awareness (Ohemeng and Oforu-Adarkwa, 2015). They further point out the necessity of balancing high and low technology approaches such as adopting a mobile government (M-government) path (Ohemeng and Oforu-Adarkwa, 2015). Shadbolt et al. (2012) analysed the socio-technical aspects of linked open government data from data.gov.uk. They make clear that the makeup of the user interface is a crucial issue by explaining ‘the ease with which ordinary citizens can access and query the data is a crucial factor for open government data’s value’ (Shadbolt et al., 2012). Huijboom and Van den Broek (2011) examined the open data strategies in five countries (Australia, Denmark, Spain, UK, and USA). They found that one of the top barriers of open data policy was the issue of limited user friendliness. They point out that ‘technical experts of several countries stated that the existing databases should be converted into more user-friendly datasets to be of use for citizens and businesses’ (Huijboom and Van den Broek, 2011). This sample of case studies which address the user perspective endorse the idea that there is a dearth of studies investigating usage of open data from the citizen perspective. They further point towards the existence of non-technical and socio-technical barriers.

3 The Research Model

Currently, there is a dearth of literature examining theory contribution and development in the open data field (Magalhaes et al., 2014). Furthermore, as Zuiderwijk et al. (2015) point out, ‘little is known about what predictors affect the acceptance and use of open data’. To address this shortcoming this research paper will attempt to contribute to the advancement of theory by developing a research model that will explain intentionality to use open data. To do so, the authors adapted and extended previous research conducted by Voorberg et al. (2015) in the area of co-creation. Through a review of the pertinent literature, we were able to validate the first three constructs identified by Voorberg et al. (2015). We further validated the risk aversion construct and added trust as a supplementary factor owing to a symbiotic relationship which exists between the two constructs. Finally, we developed the construct of simplicity of task as the academic literature pointed towards its importance and necessity.

Table 2: Prominent Factors in Citizen Co-Creation

Construct	Definition	Reference
Citizen Characteristics	Skills, intrinsic values and levels of education.	Voorberg et al., 2015, Bharti et al., 2014, Füller, 2010, Etgar, 2008, Oreg & Nov, 2008, Payne et al., 2008, Alford, 2002.
Citizen Awareness/Ownership	Taking part and being part of something.	Voorberg et al., 2015, Füller, 2010, Zwass, 2010, Etgar, 2008, Alford, 2002
Presence of Social Capital	Networks together with shared norms, values and understandings that facilitate co-operation within or among groups.	Bharti et al., 2014, Voorberg et al., 2015, Zwass, 2010, Wasko & Faraj, 2005.
Risk Aversion/Trust	Risk averse attitude/trust in process.	Voorberg et al., 2015, Füller et al., 2009, Etgar, 2008, Jaworski & Kohli, 2006, Alford, 2002.
Simplicity of Task	The ease in which the objective is completed.	Elina Jaakkola et al., 2015, Zuiderwijk et al., 2015, Kohler et al., 2011, Haichao et al., 2011, Alford, 2002.

It is our belief that these prominent factors in citizen co-creation represent moderating variables that have the potential to alter the relationship between the citizen and the outcome of open data usage. This is visually represented below in figure 1.

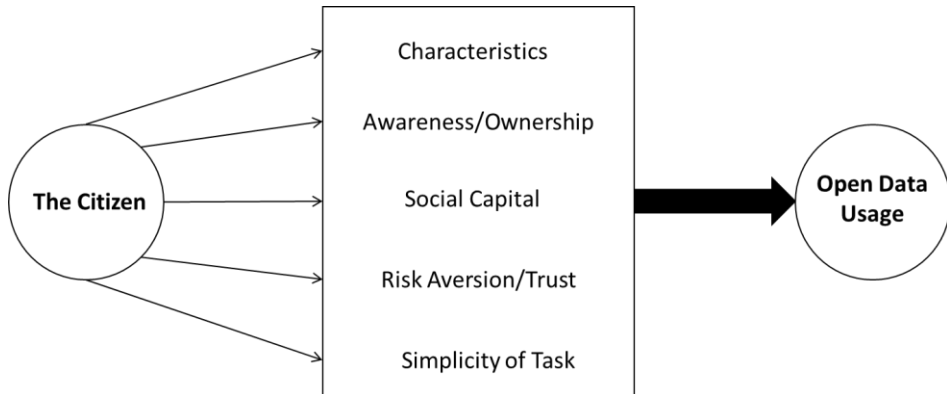


Figure 1: Research Model

4 Conclusion and Future Work

The next step of this ongoing research will be to design and conduct an exploratory cross-sectional pilot survey with current open data users, focusing on the individual as the unit of analysis. To establish the strengths of our survey constructs this will be followed by a series of semi-structured interviews with selected users. It is hoped this will lead to validation of the constructs mentioned previously. Special attention will be paid to theory building and theoretical contribution. Following Doty and Glick (1994, p.233) theory must contain at least three principles to be defined as theory; ‘(a) constructs must be identified, (b) relationships among these constructs must be specified, and (c) these relationships must be falsifiable’.

Opening up governmental data is riven with potential and pitfalls. How this is managed by the state will determine the accrual of potential benefits for the private sector and society as a whole. For understandable reasons, previous and current research has focused on technical and operationalisation issues. However, if tangible benefits are to be realised greater attention needs to be paid to the end user. The authors propose a research model from the perspective of the user by employing the theory of co-creation that will help in developing increased understanding of intentionality to use open data. The contributions of this study are twofold. Firstly, adapting and extending prominent factors in co-creation with a view to applying them to intentionality to use open data. Secondly, the attempt to build theory in the area of open data which has been under investigated thus far.

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Digital Coaching to Build Sustainable Wellness Routines for Young Elderly

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Abstract Our focus is on digital wellness services for the “young elderly” (the 60-75 years old) age group. Wellness services will help young elderly people to improve and maintain their independence and their functional capacity. Digital coaching will help the users to build good and effective wellness routines and to sustain and develop them for better health. Potential early adopter groups are identified and the functionality of digital coaching for wellness services is worked out.

Keywords: • Digital coaching • Digital wellness services • Wellness • Young elderly • Ageing population •

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1 Background

The proportion and socioeconomic relevance of ageing citizens is already high in most EU countries and there is growing political pressure to find trade-offs between the costs and the substance of the care programs.

The young elderly (the 60-75 years old) age group represents 18-23 % of the population in most EU countries; this is a large segment of the population that according to recent statistical estimates will be about 97 million EU citizens by 2020. For example, this age group will represent 22.6 % of the Finnish population by 2020 and has already reached 1.7 million in Sweden (2015) and 10 million in Italy (2016) (WHO 2014). Furthermore, given their income level and accumulated wealth, the young elderly represents very large and growing markets for digital wellness services, especially in higher per capita income EU countries.

This demographic trend has clear economic and scientific implications (cf. UN 2014). The opportunities and challenges offered by the young elderly market in most EU countries, is a market that so far mostly has been ignored by mobile service developers and providers, offering progressive companies new areas for expansion across the EU and beyond. It also provides fertile ground for collaborative research as it offers potential for researchers to work to find innovative solutions for large user groups, testing and anticipating the benefits and impacts of deploying digital wellness services among the young elderly.

We have seen the need to build an industry/research collaboration program to work out the means to build sustainable wellness routines for young elderly that would (i) be progressive and innovative enough to get their interest, (ii) be adaptive and useful enough for their individual needs to get adopted as part of daily routines, and (iii) be flexible and meaningful enough for the users and their changing context so that wellness routines would become sustained and contribute over time to better health and quality years for the ageing population.

The program, which has been worked out in both a national and a H2020 version, is called Digital Wells and has the ambition to help form and support interventions in the daily routines of young elderly so that the interventions form wellness routines. In turn, these routines will help to preserve physical, cognitive, mental and social wellness for the young elderly and help to build the basis for healthier elderly years. To make the interventions usable, practical and sustainable a virtual coach – VAIDYA – has been designed to ease and support the adoption of digital wellness services among the young elderly and to pave the way for some quickest possible go-to-market initiatives (VAIDYA is an acronym for Virtual Assistance for Intelligent Digital wellness services for Young elderly Autonomy; Vaidya (Sanskrit: वैद्य) is a Sanskrit word meaning "physician"; Pranabhisar Vaidya - the ones who protect lives by curing diseases and exhibits complete knowledge theoretically as well as practically (Wikipedia)).

2 Introduction

The society needs to have a strategy and priorities for the young elderly which are – and need to be – different from the strategy and priorities for the senior (75+ years old) age group. A majority of the young elderly are healthy, active and socially in-teractive and do not require much intervention or support from the health and social care systems of the society. The logic behind working out digital wellness services for the young elderly is that improved health in this age group will significantly raise the probability for continued improved health in the senior age group, for which ill-health among large numbers of citizens turns out to be very expensive (in Finland the health care costs for the 65+ age group was 3.8 B€ in 2014; statistics show that a Finnish citizen on average spends 80% of their lifetime health care costs during the last 10 years of his/her life) (Statistics Finland 2014).

We use wellness (which is more precise than well-being) as the target concept as wellness will tackle different aspects of functional impairment. The WHO defines wellness as “the complete mental, physical as well as social well-being of a person or groups of persons in achieving the best satisfying or fulfilling life and not merely the absence of disease or any form of infirmity (WHO 2014). There has been lively debate over the years about the dimensions of wellness; UCR [12] has compiled the following seven dimensions (here abbreviated):

- Social Wellness is the ability to relate to and connect with other people in our world.
- Emotional Wellness is the ability to understand ourselves and cope with the challenges life can bring.
- Spiritual Wellness is the ability to establish peace and harmony in our lives.
- Environmental Wellness is the ability to recognize our own responsibility for the quality of the air, the water and the land that surrounds us.
- Occupational Wellness is the ability to get personal fulfilment from our jobs or our chosen career fields while still maintaining balance in our lives.
- Intellectual Wellness is the ability to open our minds to new ideas and experiences that can be applied to personal decisions, group interaction and community betterment.
- Physical Wellness is the ability to maintain a healthy quality of life that allows us to get through our daily activities without undue fatigue or physical stress.

Adams (2003) and Els & de la Rey (2006) show the need for holistic wellness models and have tested this approach with a large empirical study. Here we will avoid any conceptual debate and use the following definition: wellness – to be in sufficiently good shape of mind and body to be successful with all requirements of everyday routines. The choice of wellness instead of health has the benefit that we are not dependent on access to health data that is strictly regulated in most EU countries with confidentiality and privacy limitations.

In this paper we will operate with wellness in two dimensions - intellectual wellness and physical wellness.

There are of course challenges for introducing digital wellness services; the first challenge is that common wisdom has it that young elderly do not have smartphones. Statistics now show that smartphones are becoming affordable general purpose instruments and will be even more so by the year 2020 (the mobile connection subscriptions are more than 100% of the population in most EU countries; the proportion of smart phones is closing on 70% in several EU countries). Recent statistics (<http://www-teleforum-ry.fi>) shows that the number of smartphones in Finland was 6.029 million in 2016 (about 73 % of the young elderly had a smartphone, cf. section 2); on an average Finnish consumers had 20 apps installed on their smartphones, of which 4 were paid (less than the EU average).

A second challenge is the doubt that digital wellness services will be at all attractive to the young elderly; this follows on a belief we have found in the market for mobile value services (Bouwman et al. 2008, 2014, Carlsson & Walden 2012, 2014) that (i) elderly people will not learn how to use services on mobile phones, (ii) there is no real use for mobile services in their daily routines, (iii) advanced technology should be developed for young people – and (iv) if elderly people use the services it will create the wrong brand image for the service developers. We have now been running a research and development program for digital wellness services 2014-17 with support from two associations for elderly with more than 100 000 members; our findings show that the mobile service market beliefs are misconceptions.

A third challenge is to work out (i) empirically verifiable results on the intervention with digital wellness services, (ii) valid, theory-based results on how the design of digital wellness services will match the multiple wellness criteria, and (iii) empirical verification on how digital wellness services will help reduce functional impairment. There are several research methodologies available to meet this challenge; here we will summarize the three methodologies we are using.

Action research has been one of the key directions of service design and work with information systems (Baskerville 1999) for a couple of decades and would in our present case tackle problems with the development and implementation of digital artefacts. The development work is often described as co-creative (Gronroos 2008) – “to find solutions that work and to not care too much about scientific precision”.

Design science is another possibility; this is fundamentally a problem solving paradigm with roots in engineering and science and is working out designs in order to find ways to tackle real-world problems. Design science research is described as a paradigm in which a designer answers questions relevant to human problems via the creation of innovation artefacts that will contribute new knowledge (Hevner et al. 2010, Lahrmann et al. 2011, Mettler et al. 2010). The designs build on an understanding of what is needed to deal

with the problems; the design is both a process (a set of activities) and a product (called an artefact) and both can be validated and verified to be logically consistent and technically free of errors.

Action design research (ADR) (Sein et al. 2011) found that design science is too technologically oriented and is not paying enough attention to the organisational or user context of the artefacts. The ADR works with digital artefacts that are ensembles shaped by the user context both when designed and developed and when used. The ADR deals with the dynamics and the complexity of the context – in our case the interventions to create wellness routines - that are problems for engineering-inspired methods; we use the ADR in our research program.

The fourth challenge is the realisation that we cannot just create digital services and everything will then take care of itself. This shows that we need to support the building of an infrastructure (typically of SMEs) for design, development, implementation, commercialisation and maintenance; the approach that we propose is to build an ecosystem of service and infrastructure developers and providers and to support them with theory and methodology for agile business SCRUM processes (Bouwman et al. 2014).

The paper has been structured in the following way: in section 1 we gave the background and in section 2 the key definitions and a summary of the methodology; in section 3 we summarize results from a study of the acceptance and use of mobile apps and attitudes to wellness among young elderly on the Åland islands; in section 4 we introduce the principles of digital coaching and synergistic hybrid wellness solutions; section 5, finally, gives a summary and some conclusions as a basis for the continued work on wellness services.

3 Young Elderly on Mobile Apps and Wellness

We will start by addressing two of the challenges we identified (“young elderly do not have smartphones” and “it is doubtful that digital wellness services will be at all attractive to the young elderly”). In a recent project we cooperated with the association for elderly in the city of Mariehamn (in the Åland Islands) and asked them to invite their young elderly to participate in a survey in the fall 2015; we collected 101 usable answers (26.6 % response rate) (see Carlsson & Walden 2016, Carlsson & Carlsson 2016, for details).

The proportion male/female is 44.6/54.5%; 83.1% of the respondents belong to the young elderly, and a further 14.9% are a bit older; 65.3% are married and 14.9% are widowed; 77.2% have a university or technical/commercial degree (university education is rather rare for this age group, which is why we combined it with the more common second level degrees), 20.8% have a basic education.

In the sample 75.2% are retired and 23.8% are working full- or part-time or are carrying out voluntary work; the most typical annual incomes before tax is < 30 k€ (51.5%), 30-40 k€ (19.9%), 40-50 k€ (9.9%) and >50 k€ (17.8%). These profiles are typical for the Åland Islands and are representative for their group of young elderly; here we will use these profiles as a snapshot of the young elderly – we will add to the profiles in the following to get a fuller description of the potential users of digital wellness services.

As we plan to run the digital wellness services over smartphones we need to find out how frequent they are in the sample; we asked about the phones in use and found out that a majority (about 73%, but not all) use smartphones; this was confirmed by the result that 72.9% of the respondents use mobile apps for navigation, weather forecasting, Internet search, etc. (requires smartphones).

We added to the profiles of the young elderly by asking how useful, easy to use and valuable mobile apps are for them following Davis (1989) and Venkatesh et al.(2012) structure of questions. For the about 70 respondents that use mobile apps we found that the adoption of mobile apps scored high on a 5-grade Likert scale on several items:

- mobile apps are useful in my daily life [4.32];
- I will continue to use mobile apps [4.19];
- mobile apps help me to carry out my tasks faster [4.08];
- using mobile apps helps me to carry out important tasks [3.94];
- I can use mobile apps without assistance [3.91];
- I have the necessary knowledge to use mobile apps [3.87];
- It is easy for me to learn to use mobile apps [3.79];
- I can use the mobile apps I need with the phone I have [3.75].

The results give us some insight to build on: (i) the young elderly use of smartphones is sufficient to launch digital wellness services; (ii) the young elderly are confident users of mobile apps, which is a prerequisite for getting the wellness services adopted. This settles the first challenge (“young elderly do not have smartphones”) and as mobile apps are digital services we can also claim that the second challenge is settled for the sample in the Åland Islands. The research continues, but so far we can stick to the proposal that digital wellness services could be developed and offered on smartphones for the young elderly.

Then we moved on to get an understanding of what perceptions the young elderly have of two wellness dimensions, physical and intellectual wellness. A number of proposals scored high on a 6-grade forced scale (101 respondents):

- intellectual challenges are important for my wellbeing [4.91];
- I get sufficient intellectual stimulation from my everyday life [4.61];
- my physical health has been good compared to people around me [4.38];
- my resistance to illness is good [4.24];

- the amount of information I have to process in my daily life is suitable for me (not too much, not too little) [4.20];
- I expect my physical health to remain good [4.14];
- I expect my physical health to deteriorate with increasing age [3.94].

The results we got show that the young elderly have clear perceptions of the two wellness dimensions; thus it makes sense to develop digital wellness services. In a next step we intend to cover also the emotional and social wellness dimensions.

Then we need to find out if there are any characteristics that could single out the most promising potential users as we want to get good, strong initial adoption of the wellness services. Our idea was that relations between socio-economic characteristics, attitudes toward the use of mobile applications and perceptions about wellness would help us to identify promising potential users; details can be found in Carlsson & Walden (2016) and Carlsson & Carlsson (2016).

We first run a factor analysis with 19 statements on mobile applications and 11 statements on wellness. The results gave an indication for possible sum variables (cf. Table 1) which were tested for reliability by calculating Cronbach's alpha coefficients; the target value ($\alpha > 0.7$) was met for the constructed sum variables (their names show the groupings we found).

A non-parametric Mann-Whitney U-test was run in order to explore possible differences between gender, age (combined to two categories: –69 years; 70–), highest level of education (–higher vocational school; technical/commercial degree + university), marital status (single; in a relationship), current work status (working (full, to some extent, volunteer); retired), annual income (–30000 €; 30001–) and the level of experience of using mobile applications (routine; experienced).

We found that there were significant differences in the positive attitudes to using mobile apps between the two age groups (cf. Table 1); the younger age group was more positive (cf. mobile_apps_positive). The more educated group was experienced in using mobile apps (cf. mobile_apps_experienced). The more educated group was socially active in using mobile apps (cf. mobile_apps_social). The group with higher income gave more value to mobile apps (cf. mobile_apps_value). Males with higher income had a positive perception of (their) physical wellness (cf. physical_wellness_positive). The group with a more active work status had a positive perception of their intellectual wellness (cf. intellectual_wellness_positive). We need of course to take some care with making conclusions from the collected data; the sample of 101 respondents was not fully randomly selected and the survey was not fully reliable as we had no possibility to check the circumstances under which the questions were answered. Nevertheless, the results are interesting as the young elderly have not been much studied in this way before.

The insight we gained from the Åland island material relative to our overall vision, (i) to get young elderly interested in digital wellness services, (ii) to get them to adopt them and (iii) to make the services part of their daily routines, we should start with young elderly, who are,

- Active in full time/part time/volunteer work & advanced users of mobile apps & < 70 years
- Experienced users of mobile apps & more educated
- Males with good physical health & income > 30 k€ per year
- More educated & find mobile apps good value for the price

Table 1: Reliability analysis for six sum variables, obtained Cronbach’s alpha (all items included, *-marked item removed; used value underlined) and corrected Item-Total Correlation

Using mobile applications - statements	Corrected Item-Total Correlation [>0.3 recomm.]
I have the knowledge needed for using mobile applications [Q9_6]	0.727
It is easy for me to learn to use mobile applications [Q9_8]	0.819
<i>I can use mobile applications that I want with my current phone [Q9_9]* NOT included</i>	0.580
I think that mobile applications are user-friendly [Q9_10]	0.809
It is easy for me to become skilful in using mobile applications [Q9_12]	0.787
I'm using mobile applications without the help of others [Q9_17]	0.760
SUM variable I: Mobile_apps_positive Cronbach's alpha	0.904 | <u>0.913</u> when *item deleted
I think that mobile applications are useful in my everyday life [Q9_1]	0.814
<i>People who are important to me think that I should use mobile applications [Q9_2]* NOT included</i>	0.656
The use of mobile applications increases my ability to take care of things that are important to me [Q9_3]	0.836
Mobile applications will help me to accomplish tasks more quickly [Q9_5]	0.773
Using mobile applications increases my productivity [Q9_7]	0.709
Using mobile applications has become a routine for me [Q9_22]	0.829
I will continue to use mobile applications in the future [Q9_20]	0.754
SUM variable II: Mobile_apps_experienced Cronbach's alpha	0.925 | <u>0.926</u> when *item deleted
There are people who support me when I am using mobile applications [Q9_4]	0.481
I can get help if I have any problems when using mobile applications [Q9_11]	0.503
People whose opinions I value recommend me to use mobile applications [Q9_13]	0.584
Using mobile applications is very entertaining [Q9_19]	0.535
SUM variable III: Mobile_apps_social Cronbach's alpha	<u>0.729</u>
Mobile applications that cost something are reasonably priced [Q9_18]	0.700
Mobile applications give good value for the price [Q9_21]	0.700
SUM variable IV: Mobile_apps_value Cronbach's alpha	<u>0.820</u>
Compared to people around me my physical health has been good [Q10_2]	0.714
My resistance to physical illness is good [Q10_4]	0.774
<i>I expect my physical health to remain good [Q10_11]* NOT included</i>	0.593
SUM variable V: Physical_wellness_positive Cronbach's alpha	0.832 | <u>0.858</u> when *item deleted
I look for challenges that require thinking and reasoning [Q10_1]	0.585
The amount of information that I have to process during a normal day suits me very well (not too much, not too little) [Q10_7]	0.557
I get sufficient amounts of intellectual challenges in my everyday life [Q10_3]	0.619
Intellectual challenges are important for my well-being [Q10_10]	0.651
SUM variable VI: Intellectual_wellness_positive Cronbach's alpha	<u>0.791</u>
I avoid tasks that require that I concentrate on them [Q10_5]	0.333
I expect my physical health to deteriorate with increasing age [Q10_6]	0.341
I have often found that my life lacks in intellectual challenges [Q10_9]	0.503
My physical health puts constraints on my everyday activities [Q10_9]	0.341
SUM variable NOT constructed Cronbach's alpha	<u>0.593</u>

4 Digital Coaching through Digital Fusion

In early work with the young elderly (Carlsson & Walden 2014, 2015) we found that the interest in using digital well-ness services on smartphones started to decrease after 2-3 months of continued use; when the services were combined with activity bracelets the period of active use doubled to about 4-6 months. These are early indicators and have something to do with the fact that there is a one-time cost for the activity bracelets (the smartwatches cost around 350 €, the more advanced bracelets 120-250 €, the cheap bracelets 40-50 €). This follows the pattern, that if you have paid for a bracelet you keep up the wellness routines in order to get value for the money you have spent. In an Insight report (<http://www.nuance.com>) it was found that 95% of applications on smartphones are abandoned within 1 month of download; Gartner found that the abandonment rate of smartwatches is 29%, and 30% for fitness trackers in a study with more than 9500 participants in Australia, U.K. and the U.S.

This creates a dilemma for building wellness routines. In order to get health effects among the young elderly the wellness routines need to be sustained for at least 3-5 years, the ideal would be to keep them up for 15-20 years, i.e. well into senior years; there is a need to build variety and advanced, intelligent functionality into the digital wellness services. A way to deal with this dilemma is coaching, i.e. to make variety and innovative, advanced functionality part of the digital wellness services, which will keep the services interesting. The material we worked out in section 2 already gave us some insight about the young elderly and this should be a starting point for giving the users individual advice and guidance on how to improve their wellness routines (coach-ing) as a function of how advanced they are and what their goals and objectives are. Personal trainers/coaches have been proposed but will be too expensive.

We have worked out the functional requirements of the digital coach called VADIYA:

- The coach builds on digital fusion: fusion of heterogeneous data sets ((i) individual data, (ii) group/cluster data, (iii) big user group data) from 100+ applications and devices; algorithms to build information from data sets; fusion of sets of information with computational intelligence methods; ontology (fuzzy, soft) to build knowledge from sets of information; approximate reasoning and soft computing for knowledge fusion
- Coaching is built with data, information and knowledge of different granularities (i) context dependent, (ii) individual wellness, goals, (iii) “good practice”
- Coaching is adaptive to national language, cultural habits, changes in legislation
- VADIYA coaching is continuous and is built to change dynamically; should be maintained, supported, enhanced, changed, developed (sometimes radically)
- VADIYA is unobtrusive technology: virtual coach on smart phone + omnivore platform that will have 100+ interface solutions for sensor data + data from wearables + new innovations

- VAIDYA builds on ideal wellness profiles that are worked out; for individuals, for groups/clusters of similar service users, for countries with similar cultures and traditions, etc.; deviations from the ideal profiles worked out with (fuzzy) MCDM methods to offer recommendations of how to make optimal steps towards the ideal profiles

A digital personal coach was proposed by Schmidt et al. (2015) to help fitness tracker users to personalize their training. The coaching builds on partially observable Markov processes and Markov decision processes that use data from the fitness trackers; when reported the coach was in first prototype development. The implementation and use of Markov processes may offer some challenges.

The digital fusion is needed as data will be multi-dimensional in each one of the four different wellness aspects. Some of the data can be collected with sensors (physical and social wellness) other parts will need a gamification interface and support (cognitive and mental wellness) (Hamari et al. 2014). Part of the data needs to be in real time; part of it can be daily and weekly summaries. We will need digital fusion to operate with heterogeneous data from different contexts and for different forms of wellness. All of it should be presented in an understandable and tailorable form for young elderly users, which is known as knowledge fusion.

The fusion methods and technology will add value to the digital wellness services:

- data fusion offers summary statistics from (several) apps and devices, goal attainment over days, weeks, months
- information fusion produces trends, deviations from trends, targets and target revisions; shows levels usually reached by similar service users
- knowledge fusion compiles activities to combine, add, enhance information for advice & support; tailors enhanced activity programs

An illustration of the differences between data, information and knowledge in the wellness context was collected from a Polar A360 activity bracelet and is shown in fig. 1.

In work with young elderly groups (Carlsson & Walden 2014, 2015) discussion quite often focused on wellness as a sum of different activities and it was pointed out that “my best (individual) wellness is not achieved by maximizing my physical wellness, but by finding some smart combination of intellectual, physical and social wellness”. Further study showed that wellness could be synergistic, i.e. that combinations of different forms of wellness could be “more than the sum of the individual wellness forms”. Orienteering can produce synergistic wellness: (i) it offers cognitive and intellectual challenges in finding the optimal paths through the forest; (ii) it is one of the physically most demanding sports; (iii) the “family of orienteers” is closely knit - also internationally – and promotes social wellness.

Similar versions of synergistic wellness activities can be found among the young elderly – concerts offer intellectual, emotional and social wellness; volunteer help and support of senior citizens offer physical, emotional and social wellness; singing in choirs offer emotional and social wellness, and so on.

The digital coach VADIYA should provide advice and support for synergistic wellness activities - and for hybrids of wellness activities that work out innovative and some-times unique combinations that would offer new challenges for the young elderly users. There is of course the question of time for various activities and support for trade-off between wellness activities, i.e. how to get the best wellness value for time allocated to various activities (which sounds a bit like “productivity of working time”).

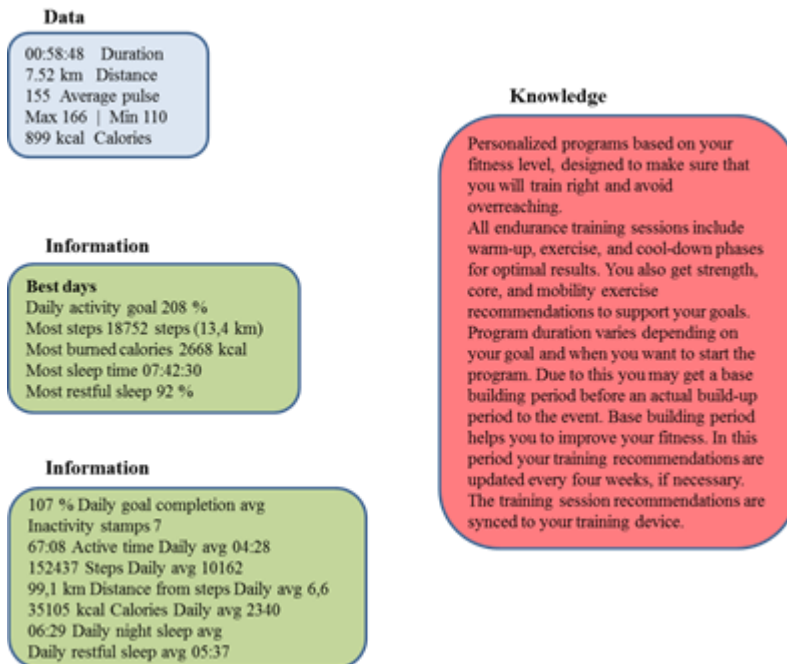


Figure 1: Data, information and knowledge fusion

5 Summary and Conclusions

We noted that the proportion and socioeconomic relevance of ageing citizens is high in most EU countries but that the young elderly has been ignored by the politicians worrying about the ageing population as they are “too active, and in too good shape” to request any budget-funded support from the society.

Thus there are two cases of missed opportunities: (i) there is a potential market for digital (mobile) services that represents 18-23% of the population in most EU countries; the young elderly are estimated to be 97 million by 2020 in the EU countries (a market that should get some business attention); (ii) interventions that create sustainable wellness routines among the young elderly will reduce the probability for serious illness among the senior citizens.

We use wellness as the target concept – to be in sufficiently good shape of mind and body to be successful with all requirements of everyday routines.

In the study in the Åland islands we could identify some first groups of supportive users of digital wellness services; the first group is young elderly who are active in full time/part time/volunteer work and are experienced users of mobile apps and are < 70 years; the second group is young elderly who are experienced users of mobile apps and are more educated; the third group is young elderly who are males with good physical health and an income > 30 k€ per year; the fourth group is young elderly who are more educated and find mobile apps good value for the price.

Work with young elderly groups pointed to a dilemma: interest for mobile and digital services tends to diminish rather quickly (in 3-5 months, with activity bracelets in 4-6 months) but wellness routines need to be sustained for at least 3-5 years to give positive health effects. We proposed to introduce digital coaching as part of the digital wellness services to make the use of them sustained. There is no doubt that much work remains to get wellness routines built and adopted by the young elderly.

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The Relation Between Process Management and Innovation – A comparison of the IT and Manufacturing Industries

THOM CATS & PASCAL RAVESTEYN

Abstract This study investigates whether there are major differences between process management and innovation between the IT and more traditional industries. Although both industries are quite similar, the research results show that the IT industry is more innovative in comparison to more traditional industries. The traditional industries are more risk averse towards new technologies, which makes them less innovative than the IT industry.

Keywords: • Business Process Management • maturity models • innovation value chain • innovation adoption • IT industry • manufacturing •

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1 Introduction

During the last few years there have been many changes for organisations on a global level. Nowadays, through globalisation and the internet, markets change quicker and organisations have a limited amount of time to adopt new trends or change their business models. Therefore, the European Commission (2017) states that innovation is critical in order to improve existing products, services and processes or develop new ones that add value to an organization and increase Europe's competitiveness on a global economic level. However, besides innovation, organizations are also focusing more and more on the efficiency and effectivity of their processes and therefore business process management (BPM) is getting more attention (Plattfaut et al., 2011; Ravesteyn et al., 2012; Gabryelczyk, 2016). BPM plays a vital role in addressing the priorities of current Chief Information Officers (CIO) because BPM is a key instrument in managing and improving organizational processes with information systems (Gartner, 2010; Plattfaut et al., 2011).

Scientific studies that find that BPM maturity models support organizational performance are not new (Rosemann & de Bruin, 2005; Fisher, 2004; Davenport & Short, 1990). However recent research shows that BPM could also be an enabler to the innovation level of an organization (Vom Brocke et al., 2016). What is not described in these studies is whether there is a difference in how BPM and innovation are related between different industries. A relatively young industry such as IT might be expected to be a lot more innovative compared to more traditional industries such as manufacturing. Therefore, the objective of this study is to determine if such a difference exists. The research question for this study is as follows:

What are the differences in the relation between BPM and innovation in a comparison between the IT industry and the manufacturing industry?

This comparison is made in order to create a broader understanding as to whether and, if so, why the software industry is more innovative when compared to more traditional industries. To be able to analyse this research question a quantitative study is performed based on data collected in three IT companies and two manufacturing companies (in respectively the coffee and the jewellery industry).

The remainder of this paper is organized as follows, the next section will discuss the literature on the main constructs in our study, followed by the research method in section 3. Section 4 continues with the results and the paper concludes with the main findings in section 5.

2 Literature

The theoretical framework (see section 2.4, figure 1) of this study consists of three main constructs: Business Process Management Maturity (BPMM), innovation value chain (IVC) and innovation adoption (IA). In this section each of these constructs is discussed in more detail. For the literature study Google Scholar and the databases of Science Direct, Springer, and Wiley Online Library are used in combination with the following keywords: ‘BPMM and innovation’, ‘Business process management and innovation’, ‘innovation value chain’, ‘innovation adoption’, ‘innovation’, ‘process management and innovation’. The papers that were found were accordingly analysed to determine the relevancy, the findings are discussed below.

2.1 Business process management maturity

Business Process Management is a management methodology that exists at different organizational levels on which processes are assessed stepwise with the goal to improve the capabilities of the organisation (van Looy et al., 2013). The maturity of BPM is studied by Rosemann & de Bruin (2005), who created one of the first widely accepted BPMM models. This model is multi-dimensional since it analyses different factors, stages and contexts (Rosemann & de Bruin, 2005). This is in line with Vom Brocke et al. (2016) whom argue that most models in BPM have a “one-size-fits-all approach”, which causes problems that will not account for the situational contexts necessary to gain benefits. Furthermore, Vom Brocke et al. (2016) state that business process management supports an organization in their innovativeness.

Rosemann & de Bruin (2005) based the factors of their model on BPM critical success factors, which consist of independent and dependent variables. The assumption is that the higher the score on these variables, the higher the level of success in BPMM. Moreover, they state that an individual organisation should translate process success into the most important BPM-independent success measures. Furthermore, Rosemann & de Bruin (2005) find that there is not a standardized toolkit for every organisation to put BPMM into practice.

Fisher (2004) states that a one-dimensional five-stage model for BPMM is not enough. Fisher’s (2004) model exists of two parts, the first part is referred to as the “Five Levers of Change”, which are used to assess the capabilities of an organisation. The second dimension also exists of five factors, representing the five maturity stages of BPMM. This dimension is used to measure the performance of the “Five Levers of Change”. Fisher (2004) measures BPMM by using two different measure points. In contrast, the model of Rosemann & de Bruin (2005) measures BPMM on three levels (stage, factor and scope/context). Evidence is yet to be provided to see whether a multi-factor model is superior when compared to a two-factor model. Finally, Fisher (2004) concludes that the advantages of using BPMM models for companies is that they will improve the efficiency

and lower their costs which, in turn, could result in higher profits. All these advantages combined provide companies a competitive advantage.

Another BPPM model is constructed by Ravesteyn et al. (2012) whom used the Capability Maturity Model Integrated (CMMI) as a foundation to establish seven maturity dimensions. The CMMI model has also been used by Rosemann and colleagues in their research (Rosemann et al., 2004; Rosemann & de Bruin, 2005; Rosemann et al., 2006). As the BPMM model by Ravesteyn et al. (2012) is extensively used to research the relation to process performance this model is applied in the conceptual model of this study, here performance is substituted with innovation. In order to measure the level of BPM maturity within an organization Ravesteyn et al. (2012) used 37 items (BPM capabilities) divided over the seven dimensions. To measure the maturity level of the 37 BPM capabilities a Likert scale from 1 (low) – 5 (high) is used.

2.2 Innovation value chain

Hansen & Birkinshaw (2007) developed the innovation value chain framework. Their approach requires executives to have an end-to-end view of the innovations in their companies. Their framework will also force executives to focus on the weakest links in the innovation process of the company. The first phase is to “Generate ideas”, come up with new products or services, either from within the company or outside the company; “Convert ideas” is the second phase. At this stage the company has selected the ideas, collected the funds and started the development of the product. The third and final phase is to “diffuse” the developed product or service, this means that the developed product or service concept is used in the organisation or launched in the market. Hansen & Birkinshaw (2007) state that when a manager wishes to use these three phases of the innovation value chain the manager has to focus on six critical tasks: “Internal sourcing, Cross-unit sourcing, External sourcing, Selection, Development and Company wide spread of the idea” (Hansen & Birkinshaw, 2007, p. 122).

Ganotakis & Love’s (2012) state that the company’s resources have a significant influence on the innovation process and on the growth of the company. Ganotakis & Love’s (2012), find three main implications in their research: first, the innovation value chain makes it possible to identify the factors that enable a company’s level for growth and productivity when compared to new technological based firms. Secondly, companies which develop and market disruptive innovations show fast growth leading to better productivity and performance. The third and last implication is that the innovation value chain makes it possible to identify the innovation behaviour, focusing on the important role of R&D which influences the success of innovation.

Based on the studies by Hansen & Birkinshaw (2007) and Ganotakis & Love (2012) it can be concluded that the innovation value chain is a method that explains the process of innovation from generating ideas to converting ideas and subsequently its diffusion, which leads to new business opportunities in order to generate new revenues.

Furthermore, this approach also helps to draw the attention to an organisation's strengths and weaknesses in the innovation process.

2.3 Innovation adoption

Damanpour & Wischnevsky (2006) distinguish innovation-generation (as described above as part of IVC) from innovation-adopting. When organisations use innovation adoption the purpose is to change the organisation in such a way that it becomes more effective and develops a more competitive mind set, in order to adapt more easily to new trends in the market.

In their research Hameed et al.'s (2012) try to determine the process of IT adoption. Moreover, Al-Jabri & Sohail (2012) developed six hypotheses to show which factors have a profound influence on IT adoption. Both studies support each other: Hameed et al.'s (2012) model provides a general overview and Al-Jabri & Sohail's (2012) model offers a more specific focus on a few elements influencing IT adoption.

In an earlier study on the adoption of internet banking, Tan & Teo (2000) concluded that subjective norms lack a significant relationship with intentions. Perceived behavioural control and attitudinal factors can be used to predict the intentions (in this case to adopt internet banking services). They describe three factors (Attitude to innovation, Subjective norms, and Perceived behavioural control) which influence someone's or an organization's intention to adopt a new product or service. This is similar to the study by Al-Jabri & Sohail's (2012) in which it is concluded that the six factors together provide a solid measurement tool for innovation adoption.

2.4 Conceptual model

Derived from the theory and concepts described in the literature study above, the conceptual model (figure 1) for this research consists of three main constructs: BPM maturity, innovation value chain and innovation adoption (variables). For BPM maturity, the framework has the seven dimensions with corresponding BPM capabilities (theorems) from Ravesteyn et al. (2012). The capabilities are used as input in order to develop survey questions to measure each dimension.

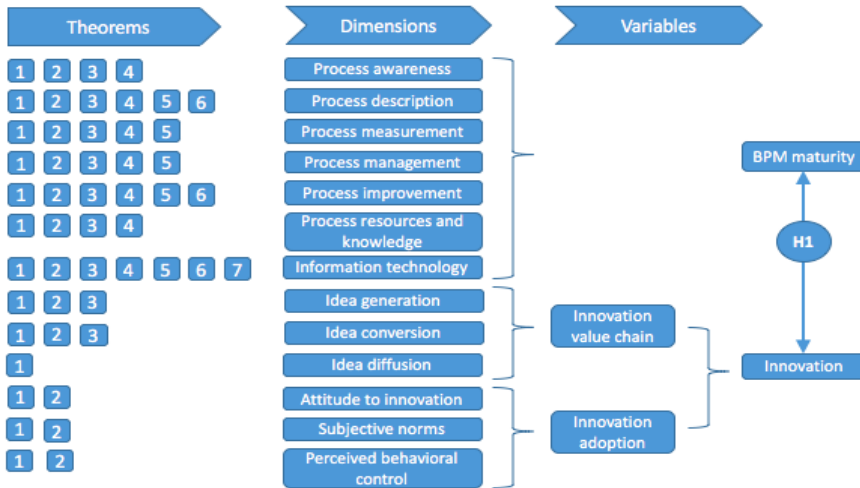


Figure 1: Conceptual model

The innovation construct in the conceptual model is split up into the two constructs innovation value chain and innovation adoption. The innovation value chain is very focused on the analysis of how innovations come up, whereas innovation adoption focuses on acceptance of the innovation by the final user or adoption of new innovations by the organization. This co-dependency results in the assumption that both theories strengthen each other. Finally, based on this reasoning, the hypothesis (H1) is that there is a positive relation between the BPM maturity and Innovation.

3 Research Method

3.1 Data collection

For this study data is used that has been collected as part of a larger research project on BPM and Innovation. For this an online survey tool was used as this makes it very convenient for the respondents to answer the questions in their own time. The data is collected across cultures and in different countries at seven companies. Three out of seven were located in The Netherlands and the other companies were located in Austria, Belgium, China and Ireland. Most of the companies are active in the software industry whereas the other companies are active in manufacturing (such as jewellery and coffee) or the finance sector.

The data was collected by a team of six researchers. To ensure the data was collected in the same manner a coding manual was developed to ensure all collected data had the same definitions. In total 200 completed surveys have been collected. In all organisations

the survey has been filled in across several departments by C-level to middle management and operational positions.

3.1.1 The questionnaire

The survey was constructed by using the structure of the conceptual model. As explained above, the conceptual model shows how many items are used for every dimension of BPMM and for the two innovation constructs. The survey contained 50 questions on the main concepts, 37 questions were divided over the seven dimensions to measure the level of BPM maturity and 13 questions addressed the innovation part. For each statement a Likert scale from 1 to 5 was used to indicate whether the participants strongly disagreed, strongly agreed or stayed neutral. In addition to that, there were also some general questions concerning how knowledgeable the participants were regarding BPM, how the respondents would define BPM, and what position they had within their organisation.

3.1.2 Validity of the research instrument

To analyse the validity of the constructs, a Varimax method was used within the factor analysis, which was developed by Kaiser (1958). A rotation factor analysis is the most commonly used method in this type of analysis (Abdi, 2003). The results, of the factor analysis showed that only six components were recognised for BPMM despite the fact that the BPMM construct consists of seven dimensions in the conceptual model. The variable innovation showed three components and there were only two in the conceptual model (innovation value chain and innovation adoption). Based on this analysis it could be argued that the conceptual model could benefit from adjustments, since not all components were recognised. Therefore, a second analysis was performed: the Cronbach alpha was used to determine the reliability of separate components (table 1). Tavakol & Dennick (2011) suggest in their article that a Cronbach alpha should be in the range of 0.70 to 0.95 (Nunnally & Bernstein, 1994; Bland & Altman, 1997; DeVellis, 2003). However, the recommended maximum value is 0.90 (Streiner, 2003). Furthermore, a low indication could be influenced by the number of questions asked for one item or poor interrelatedness between the items (Tavakol & Dennick, 2011). The results in Table 1 showed that all dimensions have a value above the minimum of 0.70 and did not exceed the score of 0.90, which indicated that the results of the collected data were statically reliable.

Table 1: Cronbach Alpha

Dimensions	Cronbach's Alpha	N of Items
Process awareness	.750	4
Process description	.895	6
Process measurement	.861	5
Management of processes	.827	5
Process improvement	.830	6
Process knowledge & resources	.745	4
Information technology	.884	7
Innovation value chain	.841	7
Innovation adoption	.735	6

3.1.3 Analysis

As Cohen (1992) states that a T-test is widely used to compare means and that it also shows whether the difference between two elements is significant or not, a T-test is conducted to compare the survey results of two sets of companies (IT and manufacturing). This is done by adding three variables in SPSS: company name, industry branch and bucket. This last variable is used to define the groups. Three companies are labelled IT and two were labelled OLD (these are the manufacturer of coffee beans and that of jewellery).

4 Analysis Results

4.1 Level of knowledge on BPM

First the respondents were asked to assess their knowledge of BPM. For this they could choose between four different levels. Out of 200 respondents (group IT: 114, group OLD: 61, another 25 respondents are out of scope as they don't fit into this classification) 35% (IT: 33%, OLD: 33%) had little to no knowledge and practical experience with BPM, 27% (IT: 32%, OLD: 21%) had some knowledge of BPM, but no practical experience, whereas 29% (IT: 29%, OLD: 34%) had some knowledge and limited practical experience with BPM (participated in 1 to 3 projects). Only 10% (IT: 6%, OLD: 11%) of all the respondents had both knowledge and practical experience with BPM (>3 projects). The percentages out of 200 respondents show that a small group of respondents was very experienced and is considered to have a high level of knowledge on BPM. Furthermore, the category OLD shows a higher percentage in this level in comparison to IT. It must be noted that the majority of respondents either had no knowledge of BPM or a limited amount of knowledge and practical experience with BPM, this might have influenced the results.

4.2 A comparison of IT and Manufacturing

Table 2 shows the mean scores for the BPM maturity dimensions between IT and OLD. The smallest difference between both groups is for measurement of process, meaning that both groups use performance indicators that assess and check processes and use this to improve processes (Ravesteyn et al., 2012). Additionally, BPM maturity dimensions' process awareness, process description and management of processes show that IT has a higher maturity level in comparison to the companies in the OLD category. From these results, it can be concluded that group IT is more aware of the impact that processes, process descriptions and process owners have within their organisation and they incorporate this in their strategy (Ravesteyn et al., 2012). The results also show that group OLD has a higher level of maturity in dimensions' process improvements and process resources and knowledge. This means that group OLD organizations try to improve their processes more often and also have a support system for process improvements in place. Group OLD also has more resources and employees with process knowledge. Finally, the information technology dimension shows a large difference between the two groups. This indicates that IT companies make more use of information technology to design and carry out processes to produce real-time measurement information in comparison to the manufacturing companies.

Table 2: Comparison on BPM maturity dimensions

Groups	IT	OLD
N	114	61
Process awareness	3,4934	3,4221
Process description	3,2456	3,1639
Measurement of processes	3,3965	3,3770
Management of processes	3,3386	3,2623
Process improvements	3,1637	3,2732
Process knowledge and resources	3,2281	3,3361
Information technology	3,5288	3,1944
BPM Maturity	3,3421	3,2899

In comparison to the findings described above, the results of the T-test analysis (Table 3) only show a significant difference on information technology (.010) with 95% confidence interval of the difference.

Table 3: T-Test on BPM maturity dimensions

Independent Samples Test			
BPM dimensions		Sig. (2-tailed)	Mean Difference
Process awareness	Equal variances assumed	.525	.07129
Process description	Equal variances assumed	.534	.08168
Measurement of processes	Equal variances assumed	.876	.01944
Management of processes	Equal variances assumed	.524	.07630
Process improvements	Equal variances assumed	.305	-.10948
Process knowledge and resources	Equal variances assumed	.335	-.10800
Information technology	Equal variances assumed	.010	.33444
BPM Maturity	Equal variances assumed	.583	.05224

Table 4, shows all means of the innovation dimensions. The results of the phases of the innovation value chain construct show that there is a small difference in regards to idea generation for both groups: both groups tend to agree that their employees are good at creating ideas on their own, but also across the organization. Furthermore, the results show that group IT has a higher mean on idea conversion whereas group OLD has a higher mean on idea diffusion. From these results, it might be concluded that group IT tends to be better in selecting, screening, and funding ideas as well as turn ideas into a minimum viable product, whereas group OLD tends to be better in getting new ideas out of the organisation.

Table 4: Comparison on Innovation

Groups	IT	OLD
N	114	61
Idea generation	3,5702	3,5628
Idea conversion	3,3392	3,2787
Idea diffusion	3,2719	3,3934
Attitude to innovation	3,6623	3,2295
Subjective norms	4,0658	4,0328
Perceived behavioural control	3,2149	2,8770
Innovation value chain	3,4286	3,4169
Innovation adoption	3,6477	3,3798
Innovation	3,5381	3,3983

The results of Table 4 also show that group IT has a higher mean on attitude to innovation and perceived behavioural control in comparison to group OLD. This shows that group IT agrees that the latest innovations benefit their organization and believe that it does not present any risk to their organization. In addition, group IT also scores higher on perceived behavioural control, which indicates that software organizations tend to use the latest innovations, but also agree to have time, money and resources to keep using these latest innovations. Furthermore, based on the subsequent T-test (Table 5), only the difference on attitude to innovation and perceived behavioural control show significance between the two categories (with 95% confidence interval). Moreover, the smallest difference between both groups is created by subjective norms, within the innovation adoption construct, which means that both groups use the latest innovation to stay competitive in the market. On top of this, customers also expect both groups to use the latest innovations.

Table 5: T-test Innovation dimensions

Independent Samples Test			
Innovation dimensions		Sig. (2-tailed)	Mean Difference
Idea generation	Equal variances assumed	.951	.00733
Idea conversion	Equal variances assumed	.610	.06049
Idea diffusion	Equal variances assumed	.455	-.12151
Attitude to innovation	Equal variances assumed	.000	.43277
Subjective norms	Equal variances assumed	.794	.03300
Perceived behavioural control	Equal variances assumed	.015	.33786
Innovation value chain	Equal variances assumed	.914	.01171
Innovation adoption	Equal variances assumed	.008	.26788
Innovation	Equal variances assumed	.116	.13979

As a result of the analysis described above it is possible to conclude that group IT only differs on two dimensions of the conceptual model when compared to other companies. This indicates that, based on this analysis, IT companies tend to be more innovative than manufacturing companies. For traditional organisations this is confirmed by Rosemann (2012) and vom Brocke et al. (2016), who both suggest that BPM does not support the innovation process because it only provides methods and techniques, which support the development of a structure to analyse an organisation.

5 Conclusion

5.1 Main findings

In this research the objective was to answer the question:

What are the differences in the relation between BPM and innovation in a comparison between the IT industry and the manufacturing industry?

Based on our analysis of the differences between IT industry (software companies) and manufacturing (coffee and jewellery companies) we find that these industries are very similar when it comes to the relation between BPM and Innovation. They only differ significantly on the BPM dimension information technology and the innovation adoption dimensions' attitude to innovation and perceived behavioural control. As Tan & Teo (2000) concluded in their study on mobile banking adoption that perceived behavioural control and attitudinal factors are the key elements that can be used to predict the intention to adopt a new technology, it might be concluded that the IT industry is a step ahead of

the manufacturing industry in terms of using information technology and are also able to adapted more quickly to new innovations that are beneficial to their organization, this is something which is to be expected given the nature of IT companies.

5.2 Implications

The IT industry and manufacturing industry are surprisingly similar. However, based on this study we find that the manufacturing industry should put more effort towards adopting new technologies in order to be more innovative. For example, organizations can invest more in the latest technologies that could produce real-time measurement information in support of the daily business operations. Besides, investing in new technologies it is also essential to invest in the knowledge of people in order to get the optimal performance out of the latest technologies.

5.3 Limitations

A limitation of this study is that data is collected across different industries but also from different countries within Europe and China. Thus, cultural differences could have influenced the answers as Lee et al. (2002) showed that different cultures have different perceptions, therefore our scale for answering the statements could be interpreted differently. Additionally, in this study a Likert scale is used to measure all the dimensions of BPM and innovation based on the most well-known scale from 1 (strongly disagree) to 5 (strongly agree) (Likert, 1932; Gliem & Gliem, 2003), however, literature suggests that a five-point Likert scale is a minimum but it is better to have a broader scale (Allen & Seaman, 2007). Hinkin (1995) researched scale developments and within his review a majority of the researched studies used a five-point scale. Although, the second biggest group used a seven-point scale. According to these results the cultural influence on the Likert scale and the scale-size are arguable and therefore seen as a limitation in this study. Furthermore, in this study a T-test is conducted to investigated the significant differences based on the means between two constructs. As there are also other techniques available to analyze the data, this is also considered as a limitation.

5.4 Recommendations for future research

This study has gone some way towards enhancing the understanding of the relationship between BPM and innovation. The conceptual model still needs some refinement because the factor analysis only recognised six out seven BPM dimensions and for innovation three instead of two dimensions. Moreover, more research is required to improve the understanding of the relationship between BPM and innovation within and between different organizations and sectors as well as across cultures.

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Content Analysis in Support of Critical Theory Research: How to Deliver an Unwelcome Message Without Being Shot

ROGER CLARKE

Abstract The notion that the powerful shoot messengers who bear unwelcome messages goes back to at least Plutarch and perhaps as far as Sophocles. Researchers whose work is adjacent to, rather than directly within, the disciplinary mainstream, may at times feel that this applies even in academic disciplines. This paper reports on a journey undertaken in order to achieve publication of a critique of papers published in a Special Issue of a leading eCommerce journal. The literature on content analysis was first examined, with particular reference to a range of approaches to literature reviews. Conventional, directed, summative and computational content analysis techniques were considered, and exemplars in the IS literature identified. Because the critique has been undertaken in the critical theory research tradition, the role of criticism in research was also reviewed. The findings enabled refinements to be made to the protocol used for conducting the content analysis, together with strengthening of the robustness of the paper's research method section and improvements to the expression of the research findings.

Keywords: • Qualitative Research • Literature Review • Hermeneutic Literature Review • Critical Discourse Analysis •

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1 Introduction

This paper reports on experience gained during a research project. The project involved the use of a new body of theory to critique the papers in a Special Issue of a leading eCommerce journal. The resulting paper was submitted to the same journal, and rejected. The grounds were a combination of claimed lack of robustness of the research method and dismay about the fact that the Special Issue papers had been subjected to criticism.

I found both of these grounds bewildering. The research method had been carefully prepared, had been previously applied and the results published, and it was, I considered, suitably documented. Moreover, the suggestion that papers should not be subjected to criticism sounded to me like the antithesis of the scientific method to which the journal and the management disciplines generally claim to aspire.

I accordingly set out on a deeper study of meta-questions that were affecting the project. What guidance is available in relation to secondary research whose raw data is published academic papers? What particular approaches need to be adopted when the theory-lens through which the observation is being performed arises from critical theory research? What guidance exists for expressing the outcomes of research of this nature? This paper's objective was accordingly to enhance the publishability of the underlying research, by grounding the content analysis technique more firmly in the research methods literature, demonstrating the appropriateness of constructive criticism of published works, and improving the expression of the results.

The paper is structured as follows. Brief explanations are provided of the underlying theory, the Special Issue to which it was applied, the research method adopted, and key aspects of the review process. A series of investigations is then outlined, involving searches of relevant methods literatures. This encompasses several variants of literature reviews and content analysis. The nature of criticism is discussed, and critical theory research reviewed. It is concluded that two particular techniques provide the most useful guidance on how to approach a project of this nature.

The paper concludes by showing how the insights arising from the journey have enabled enhancements of the research method, and of the manner in which the method and the findings are communicated to the reader.

2 Researcher Perspective

The underlying research project adopted the particular theoretical lens of 'researcher perspective'. This was defined in Clarke (2015, 2016b) as:

the viewpoint from which phenomena are observed

The papers postulated that:

In each research project, at least one 'researcher perspective' is adopted, whether expressly or implicitly, and whether consciously or unconsciously.

The researcher perspective influences the conception of the research and the formulation of the research questions, and hence the research design, the analysis and the results.

Each particular perspective is specific, not universal.

Because the interpretation of phenomena depends on the perspective adopted, the adoption of any single researcher perspective creates a considerable risk of drawing inappropriate conclusions.

IS researchers generally adopt the perspective of a participant in an information system (IS) – commonly the organisation that runs it, or an organisation that is connected to it, but sometimes the individuals who use it. Occasionally, researchers may adopt the perspective of an external stakeholder or 'usee', by which is meant a party who is affected by the IS but is not a participant in it.

Studies of several samples of refereed publications in the IS literature have shown that a very large proportion of research adopts solely one particular perspective – that of 'the system sponsor'. By that term is meant the organisation that develops, implements or adapts a system, process or intervention, or for whose benefit the initiative is undertaken.

The theory advanced in Clarke (2015, 2016b) argues firstly that the single-mindedness of IS researchers is frequently harmful to the interests of other stakeholders, but secondly that the interests of system sponsors are also badly-served by such single-perspective research. Higher-quality research will be achieved through greater diversity in single-perspective research, by dual-perspective research, and by multi-perspective research.

3 The Critique of the Special Issue

The above theory relating to researcher perspective was applied to a Special Issue of the journal *Electronic Markets*, on 'Personal Data Markets', which was published in Volume 25, Issue 2 (June 2015).

A market is a context in which buyers and sellers discover one another and transact business, and inherently involves at least two participants, but usually considerably more participants and other stakeholders. The digital surveillance economy that has emerged since c. 2000 is a complex web of markets. Moreover, it involves vastly more capture of consumer data than has ever previously been the case, expropriation of that data for a wide variety of purposes by a wide variety of corporations, and its application to

narrowcasting of advertisements, behaviour manipulation and micro-pricing. It would therefore appear reasonable to anticipate that projects would adopt varying researcher perspectives.

In order to investigate the researcher perspectives adopted in the papers in the Special Issue, a research method was applied that had been developed and refined in several previous studies, some of them reported in Clarke (2015, 2016b). The process specification used is in Annex 1.

One important aspect is the extraction of the Research Question (or in the case of constructivist approaches such as Design Science Research, the Objective). In some papers this is explicit, and in others implied, but in some it needs to be inferred. The most vital part of the study is the identification and interpretation of passages of text that disclose the perspective adopted by the researcher. Again, this may be explicit, but it is more commonly implicit, and in many cases it has to be inferred. In order to enable audit, the process includes the recording of the key passages that led to the interpretations made, and publication as Supplementary Materials of the process specification, key passages, codings and interpretations for each paper.

The paper was submitted to Electronic Markets in February 2016, went through two rounds of reviews, and was rejected in January 2017. The primary grounds were "[the research article format is not] appropriate, legitimate, or even warranted", "[inadequate] description of the research method used" and "overstated criticism". Each of these was a major surprise, given that copious information was provided about the research method, and critiquing of the existing state of theory is fundamental to any discipline that claims to be scientific.

It was plainly necessary for me to assume hostility on the part of reviewers, step back, and gather the information needed to convey to reviewers the appropriateness of the research method and of criticising prior published works. This led to works on content analysis in its many forms, and on the role of criticism in the IS discipline.

4 Related Content Analysis Techniques

A significant proportion of research involves the appraisal of content previously uttered by other people. This section briefly reviews categories of research technique whose focus is adjacent to the topic addressed in this paper.

4.1 Qualitative Research Techniques

Qualitative research techniques such as ethnography, grounded theory and phenomenology involve the disciplined examination of content, but content of a kind materially different to refereed papers. The text may be generated in natural settings (field research), in contrived settings (laboratory experiments), or in a mix of the two

settings (e.g. interviews conducted in the subject's workplace). The materials may originate as text, or as communications behaviour in verbal form (speech in interviews that is transcribed into text), as natural non-verbal behaviour ('body-signals'), or as non-verbal, non-textual communications behaviour (such as answering structured questionnaires). In other cases, text that arises in some naturalistic setting is exploited by the researcher. Commonly-used sources of this kind include social media content, electronic messages, and newspaper articles.

The issues arising with analysis of these kinds of content are very different from those associated with the analysis of carefully-considered, formalised content in refereed articles.

4.2 Informal Literature Reviews

A context that is more closely related to the present purpose is the examination of substantial bodies of published research. "Generally three broad categories of literature reviews can be distinguished. Firstly, literature reviews are an integrative part of any research thesis ... Secondly, literature reviews can be an important type of publication in their own right ... However, the most common form of literature review appears as a part of research publications. ... As part of research articles, literature reviews synthesize earlier relevant publications in order to establish the foundation of the contribution made by an article" (Boell & Cecez-Kezmanovic 2014, p.260).

A succinct, although rather negative, description of the approach that was common until c. 2000 is as follows: "Traditional literature reviews ... commonly focus on the range and diversity of primary research using a selective, opportunistic and discursive approach to identifying and interpreting relevant literature (Badger et al., 2000; Davies, 2000). In traditional 'narrative' reviews, there is often no clear audit trail from primary research to the conclusions of the review, and important research may be missing, resulting in biased and misleading findings, and leading to puzzling discrepancies between the findings of different reviews" (Oakley 2003, p.23).

4.3 Systematic Literature Reviews

In 2002, the Guest Editors of an MISQ Special Issue expressly set out to drive improvements in literature review techniques in IS. Their declared aim was "to encourage more conceptual structuring of reviews in IS" Webster & Watson (2002, p.xiv). The Editorial is highly-cited and appears to have had considerable impact on literature reviews published in the IS field.

The conduct and presentation of literature reviews has subsequently been influenced by the 'evidence-based' movement in the health care sector. This adopts a structured approach to the task: "Systematic reviews ... synthesise the findings of many different

research studies in a way which is explicit, transparent, replicable, accountable and (potentially) updateable" (Oakley 2003, p.23, emphasis added).

It was subsequently argued within the IS literature that a "rigorous, standardized methodology for conducting a systematic literature review" was still needed within IS (Okoli & Schabram 2010), and the authors proposed the 8-step guide in Figure 1.

5 Directly-Relevant Content Analysis Techniques

The focus in this paper is on the appraisal of published research papers. In some cases, the body of work is large. For example, many researchers have studied all articles (or at least the abstracts of all articles) in large sub-sets of papers. The sampling frame is typically one or more journals, most commonly the (atypical, but leading) 'Basket of 8' IS journals. In other cases, the body of work whose content is analysed is smaller, carefully-selected collections, perhaps as small as a single article, book or journal Issue.

In order to understand approved practices in this field of research, I adopted a two-pronged approach. Firstly, I searched out papers on the research technique. The findings are outlined in this section. In parallel, I identified relevant exemplars. Extracts from 10 such papers are in Annex 3.

Citing Weber (1990), Indulska et al. (2012, p.4) offer this definition:

Content Analysis is the semantic analysis of a body of text, to uncover the presence of strong concepts

A critical aspect of content analysis is that it seeks to classify the text, or specific aspects of the text, into a manageable number of categories. In Hsieh & Shannon (2005), the following definition is adopted (p.1278):

Content Analysis is the interpretation of the content of text data through the systematic classification process of coding and identifying themes or patterns

The authors indicate a 7-step process which they attribute to Kaid (1989). See also vom Brocke & Simons (2008):

1. formulation of the research questions
2. sample selection
3. definition of the categories to be applied
4. specification of the coding process
5. implementation of the coding process
6. quality control
7. analysis

As with any research technique, all aspects need to be subject to quality controls. Krippendorff (1980), Weber (1990) and Stemler (2001) emphasise steps 3-5 in relation to the coding scheme and its application. They highlight the importance of achieving reliability. Possible approaches include coding by individuals with strong experience in both the review of articles and the subject-matter, parallel coding by multiple individuals, review of individuals' coding by other parties, and publication of both the source materials and the detailed coding sheets, in order to enable audit by other parties.

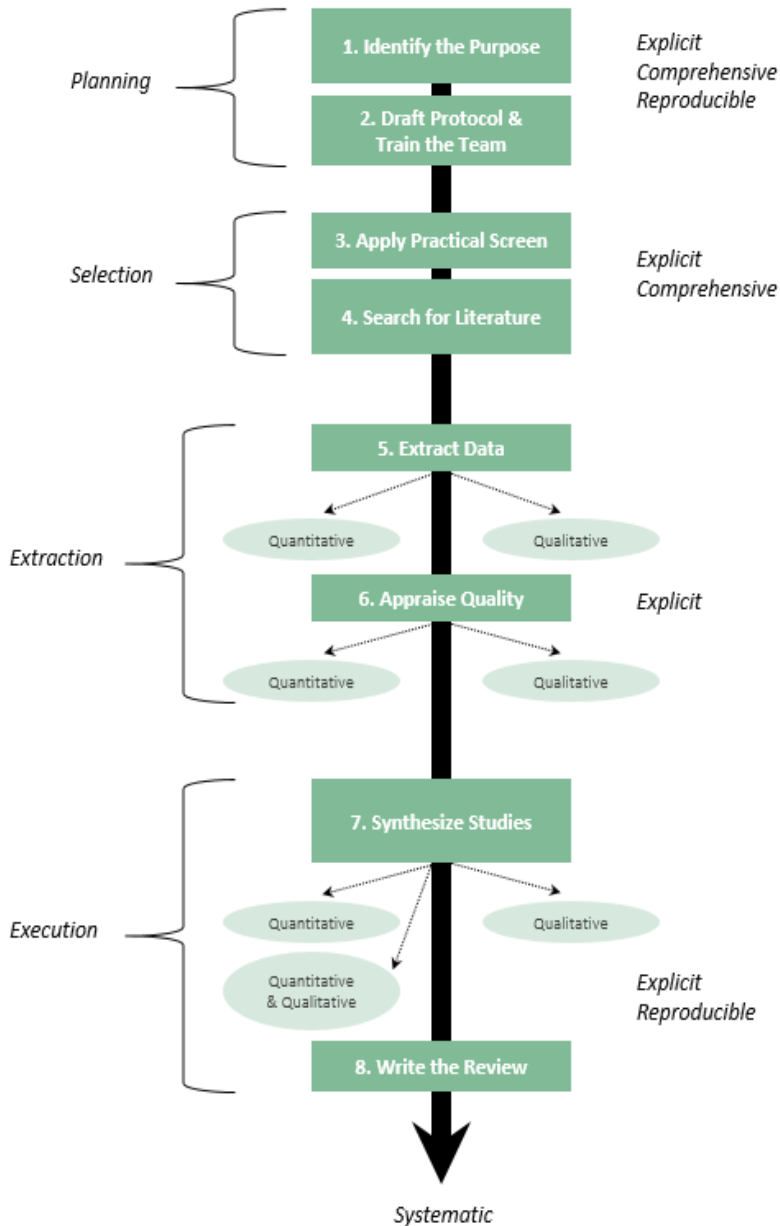


Figure 1: An 8-Step Guide for Systematic Literature Reviews – From Okoli & Schabram (2010)

Content analysis techniques exhibit varying degrees of structure and rigour, from impressionistic to systematic, and they may involve qualitative and/or quantitative assessment elements. Quantitative data may be on any of several scales: nominal, ordinal, cardinal or ratio. Data collected on higher-level scales, especially on a ratio scale, is able to be subjected to more powerful inferencing techniques. Qualitative data, on the other hand, may be gathered on a nominal scale (whereby differences are distinguished, but no ordering is implied) or on an ordinal scale (such as 'unimportant', 'important', 'very important').

Quantification generally involves measurement, most fundamentally by counting – which raises questions about the arbitrariness of boundaries, and about configuration and calibration of the measuring instrument(s). Some research methods involve sleight of hand, most commonly by making the largely unjustified assumption that 'Likert-scale' data is not merely ordinal, but is cardinal (i.e. the spaces between the successive terms are identical), and even ratio (i.e. the scale also features a natural zero).

Many authors implicitly equate quantification with rigour, and qualitative data with subjectivity. They accordingly deprecate qualitative analysis, or at least relegate it to pre-theoretical research, which by implication should be less common than research driven by strong theories. The majority of authors spend only limited time considering the extent to which the assumptions and the processes underlying the act of quantification may be arbitrary or themselves 'subjective'. Positivism embodies an implicit assumption that computational analysis necessarily leads to deep truth. The assumption needs to be tested in each particular circumstance, yet such testing is seldom evident.

A positivist approach to categorising content analysis "along a continuum of quantification" distinguishes "narrative reviews, descriptive reviews, vote counting, and meta-analysis" (King & He 2005, p.666):

- "Narrative reviews present verbal descriptions of past studies focusing on theories and frameworks, elementary factors and their roles (predictor, moderator, or mediator), and/or research outcomes, (e.g., supported vs. unsupported) regarding a hypothesized relationship" (p.667). Narrative reviews are seen as having value in some contexts, but as lacking rigour
- "**Descriptive reviews** introduce some quantification, often a frequency analysis of a body of research. The purpose is to find out to what extent the existing literature supports a particular proposition or reveals an interpretable pattern" (p.667)
- "**Vote counting**, also called "combining probabilities" ... and "box score review" ... , is commonly used for drawing qualitative inferences about a focal relationship ... by combining individual research outcomes" (p.667)
- "**Meta-analysis** is a statistical synthesis method that provides the opportunity to view the 'whole picture' in a research context by combining and analyzing

the quantitative results of many empirical studies" (p.668). Such techniques are also referred to as 'systematic review' and 'meta-triangulation'.

King & He's categorisation is helpful, but it involves a switch from largely textual source-materials in the first three categories to wholly quantitative source-materials in the fourth.

More usefully still, three approaches are distinguished by Hsieh & Shannon (2005). These are examined in the following sub-sections.

5.1 Conventional Content Analysis / Emergent Coding

In this approach, "coding categories are derived directly from the text data". The approach is effective when used "to describe a phenomenon [particularly] when existing theory or research literature on a phenomenon is limited" (p.1279). In such preliminary research, it is normal to allow "the categories and names for categories to flow from the data".

Hsieh & Shannon suggests that only selected text is examined (although that appears to be not necessarily the case), and that the context may not be well-defined. The external validity of conclusions arising from this approach may therefore be limited. They conclude that the technique is more suited to concept development and model-building than to theory development. Depending on the degree of generality of the conclusions claimed by the author, full disclosure of the text selection, coding and inferencing procedures may be merely desirable or vital.

5.2 Directed Content Analysis / A Priori Coding

In this case, "analysis starts with a theory or relevant research findings ... to help focus the research question ... and as guidance for [establishing and defining] initial codes" (pp. 1277, 1281).

Segments of the text that are relevant to the research question are identified, and then coded. To the extent that the declared or inferred content of the text does not fit well to the predefined categories, there may be a need to consider possible revisions of the coding scheme, or even of the theory on which the research design was based.

It may be feasible to draw inferences based on counts of the occurrences of categories and/or on the intensity of the statements in the text, such as the confidence inherent in the author's choice of language (e.g. "this shows that" cf. "a possible explanation is that").

As with any theory-driven research, the evidence extracted from the text may have a self-fulfilling-prophecy quality about it, i.e. there is an inevitable tendency to find more evidence in support of a theory than in conflict with it, and contextual factors may be overlooked. In order to enable auditability, it is important that not only the analysis be published, but also the raw material and the coding scheme.

5.3 Summative Content Analysis

This "involves counting and comparisons, usually of keywords or content, followed by the interpretation of the underlying context" (p.1277). The first step is to explore usage, by "identifying and quantifying certain words or content in text with the purpose of understanding the contextual use of the words or content" (p.1283).

Because of the complexity and variability of language use, and the ambiguity of a large proportion of words and phrases, a naive approach to counting words is problematic. At the very least, a starting-set of terms needs to be established and justified. A thesaurus of synonyms and perhaps antonyms and qualifiers is needed. Allowance must be made for both manifest or literal meanings, on the one hand, and latent, implied or interpreted meanings, on the other. Counts may be made not only of the occurrences of terms, but also of the mode of usage (e.g. active versus passive voice, dis/approval indicators, associations made).

The degree of analytical rigour that quantification can actually deliver depends a great deal on a number of factors. Critical among them are:

- the text selection;
- the express judgements and implicit assumptions underlying the choice of terms that are analysed;
- the sophistication and comprehensiveness of the thesaurus applied; and
- the significance imputed to each term.

5.4 Quantitative Computational Content Analysis

A decade later, it is useful to break out a fourth approach from Hsieh & Shannon's third category. This approach obviates manual coding by performing the coding programmatically. This enables much larger volumes of text to be analysed. The coding scheme may be defined manually, cf. directed content analysis / a priori coding. However, some techniques involve purely computational approaches to establishing the categories, cf. 'machine-intelligent' (rather than human-intelligent) emergent coding. The processing depends, however, on prior data selection, data scrubbing and data-formatting. In addition, interpretation of the results involves at least some degree of human activity.

In Indulska et al. (2012, p.4), a distinction is made between:

- **conceptual analysis**, in which "text material is examined for the presence, frequency and centrality of concepts, [which] can represent words, phrases, or more complex definitions"; and
- **relational analysis**, which "tabulates not only the frequency of concepts in the body of text, but also the co-occurrence of concepts, thereby examining how

concepts (pre-defined or emergent) are related to each other within the documents"

Debortoli et al. (2016), on the other hand, distinguish three alternative approaches:

- **dictionary-based text categorization**, which "relies on experts assembling lists of words and phrases that likely indicate text's membership to a particular category", cf. a priori coding
- **supervised learning methods** "[using] predefined categories; however, one does not explicitly know the mapping between text features and categories"
- **unsupervised machine-learning methods** "for categorizing text [which] find hidden structures in texts for which no predefined categorization exists", cf. emergent coding performed programmatically

Given that the 'big data analytics' movement is highly fashionable, vast volumes of data are available, and there is a comfort factor involved in office-based work much of which is automated, it would appear reasonable to anticipate that Quantitative Computational Content Analysis techniques will be a growth-area in the coming few years – at least until their limitations are better appreciated Clarke (2016a, 2016c).

5.5 Content Analysis Within the IS Discipline

Content analysis is accepted as a research technique within the IS discipline, but its use has been somewhat limited. For example, in a survey of the papers published in six leading IS journals during the 1990s, Mingers (2003) found that the use of content analysis as a research technique was evident in only four of the journals, and even in those four in only 1-3% of all papers published during that time.

In February 2017, of the nearly 15,000 refereed papers indexed in the AIS electronic library, 13 had the term 'content analysis' in the title, and 69 in the Abstract. Annex 3 presents 10 instances which together provide an indication of the range of applications and approaches. A total of 770 papers of the 15,000 contained the term – c. 5%. This is, however, subject to over-inclusiveness (e.g. where the technique is merely mentioned in passing, where the term is used in a manner different from that applied in this paper, and where the technique is applied to interview transcripts rather than to published transcripts). It is also subject to under-inclusiveness (e.g. where some other term is used for essentially the same technique). In recently-published papers, the most common forms of text that have been subjected to content analysis appear to be social media and other message content, with other categories including newspaper articles and corporations' 'letters to shareholders'.

The literature relating to the above four categories of content analysis provides a considerable amount of information relevant to the current project. However, there is a

dimension of the project that is not addressed by these techniques, and guidance needed to be sought elsewhere.

6 The Role of Criticism in Research

The previous sections have considered the analysis of content. The other area in which further insight was sought relates to the purpose for which the analysis is undertaken.

In some cases, the purpose of undertaking content analysis may be simply exposition, that is to say the identification, extraction and summarisation of content, without any significant degree of evaluation. There are benefits in undertaking content analysis in a positive frame of mind, assuming that all that has to be done is to present existing information in brief and readily-accessible form (as indeed much of the present paper does).

Alternatively, the researcher can bring a questioning and even sceptical attitude to the work. Is it reasonable to, for example, assume that all relevant published literature is of high quality? that the measurement instruments and research techniques have always been good, well-understood by researchers, and appropriately applied? that there have been no material changes in the relevant phenomena? that there have been no material changes in the intellectual contexts within which research is undertaken?

Criticism is the analysis of the merits and faults of a work. The word can be applied to the process (the sequence of actions) or the product (the expression of the analysis and the conclusions reached). There are also common usages of the term 'criticism' in a pejorative sense, implying that the critic is finding fault, is being destructive rather than constructive, and is failing to propose improvements to sustain the merits and overcome the faults. The term 'critique' is sometimes substituted, in an endeavour to avoid the negative impressions, to indicate that the work is systematic, and to bring focus to bear on the contribution being made by both the criticism and the work that is being subjected to it.

Criticism plays a vital role in scientific process. The conventional Popperian position is that the criterion for recognising a scientific theory is that it deals in statements that are empirically falsifiable, and that progress depends on scrutiny of theories and attempts to demonstrate falsity of theoretical statements: "The scientific tradition ... passes on a critical attitude towards [its theories]. The theories are passed on, not as dogmas, but rather with the challenge to discuss them and improve upon them" (Popper 1963, p.50). However, senior members of a discipline commonly behave in ways that are not consistent with the Popperian position. This might be explained by the postulates of 'normal science', which view the vast majority of research work as being conducted within a 'paradigm' and subject to its conventions (Kuhn 1962). In more practical terms, the problem may arise because senior members of any discipline have strong psychic investment in the status quo, and – nomatter how cogent and important the argument –

react negatively against revolutionary propositions. Sharply-worded criticisms appear to be more likely to be published if they are uttered by a senior about a contrarian idea, whereas they seem more likely to be deplored when they are made by an outsider about the contemporary wisdom.

Two examples are commonly cited within the IS discipline as suggesting that conservatism is important and criticism is unwelcome. In a section on the tone to be adopted in a Literature Review, Webster & Watson (2002) recommended that "A successful literature review constructively informs the reader about what has been learned. In contrast to specific and critical reviews of individual papers, tell the reader what patterns you are seeing in the literature" (p.xviii, emphasis added). The recommendation to concentrate on 'patterns in the literature' is valuable, because it emphasises that the individual works are elements of a whole. On the other hand, the use of 'in contrast to' is, I contend, an overstatement. To make assertions about a population without providing sufficient detail about the individual instances invites reviewers to dismiss the analysis as being methodologically unsound. It is, in any case, essential to progress in the discipline that each of us be prepared to accept criticism.

The advice continued: "Do not fall into the trap of being overly critical ... If a research stream has a common 'error' that must be rectified in future research, you will need to point this out in order to move the field forward. In general, though, be fault tolerant. Recognize that knowledge is accumulated slowly in a piecemeal fashion and that we all make compromises in our research, even when writing a review article" (p.xviii, emphasis added). Here, the authors' expression failed to distinguish between the two senses of the word 'critical'. The authors' intention appears to me to have been to warn against 'overly critical expression'. On the other hand, it is an obligation of researchers to 'think critically' and to 'apply their critical faculties'. I submit that it would be inappropriate for readers of the article to interpret the quotation as valuing politeness among researchers more highly than scientific insight and progress.

In the second example, a senior journal editor, providing advice on how to get published in top journals, wrote that "the authors' contributions should be stated as gaps or new perspectives and not as a fundamental challenge to the thinking of previous researchers. To reframe, papers should be in apposition [the positioning of things side by side or close together] rather than in opposition" Straub (2009, p.viii, emphasis added). This is Machiavellian advice, in the positive, or at least amoral, sense of 'if the Prince wishes to be published in top journals, then ...'. Unfortunately, it is all-too-easily interpreted as expressing a moral judgement that 'criticism is a bad thing'.

The inferences that I draw from the above analysis are as follows:

- criticism of previously-published ideas is vital to progress
- criticism encounters strong opposition from a discipline's gatekeepers, relevantly in the form of journal editors and reviewers

- to justify publication in top journals, criticism needs to be cogent, to the extent feasible addressed to theory rather than to individual theoreticians, clearly expressed, expressed no more negatively than is necessary in the circumstances, and constructive (or re-constructive) in the sense of showing how theory has been improved as a result of the analysis
- to actually achieve publication in top journals, criticism must also be devoid of any weaknesses in any of the conventions of research conduct and presentation, such that the gatekeepers, should they create unreasonable obstacles to publication, expose themselves as valuing social conservatism more highly than scientific progress

7 Critical Theory Research

Positivism and interpretivism are well-established schools of research in IS. They have been joined by design science. And they have an odd bedfellow, in the form of what is variously termed 'critical research' and 'critical theory research'. The term 'critical' in this context is different from, but related to, the sense of 'analysis of the merits and faults of a work' discussed in the previous section.

Design research is concerned with constructing an artefact, variously of a technological or an intellectual nature. Both positivism and interpretivism, on the other hand, are concerned with description and understanding of phenomena. Sometimes the focus is on natural phenomena, but frequently the interest is in natural phenomena have been subjected to an intervention. Importantly for the present project, however, both positivism and interpretivism involve strenuous avoidance of moral judgements and of 'having an agenda'.

Critical theory research, on the other hand, recognises the effects of power and the tendency of some stakeholders' interests to dominate those of other stakeholders. It brings to light "the restrictive and alienating conditions of the status quo" and expressly sets out to "eliminate the causes of alienation and domination" (Myers 1997). "Critical research generally aims to disrupt ongoing social reality for the sake of providing impulses to the liberation from or resistance to what dominates and leads to constraints in human decision-making. Typically critical studies put a particular object of study in a wider cultural, economic and political context, relating a focused phenomenon to sources of broader asymmetrical relations in society ... (Alvesson & Deetz 2000, p.1). "Critical IS research specifically opposes technological determinism and instrumental rationality underlying IS development and seeks emancipation from unrecognised forms of domination and control enabled or supported by information systems" (Cecez-Kezmanovic 2005, p.19).

In Myers & Klein (2011), three elements of critical research are identified:

- insight, which requires depth of study and is a feature also of interpretivist research. An important role is played by reflexivity: "By intentionally expressing, questioning, and reflecting upon their subjective experiences, beliefs, and values, critical researchers expose their ideological and political agendas" (Cecez-Kezmanovich 2001, p.147)
- critique, which "goes beyond interpretation to focus the researcher on the power structures that lie behind accepted interpretations" (p.24)
- transformation, which is "concerned with suggesting improvements to the conditions of human existence, existing social arrangements, and social theories" (p.24)

Appropriate approaches to critical theory research are highly inter-related with the subject-matter, and hence theorists of critical research method avoid offering a recipe or even a process diagram. Myer & Klein (2011) does, however, offer guidance in the form of Principles for Critical Research (pp.24-29):

The Element of Critique

1. Using core concepts from critical social theorists
2. Taking a value position
3. Revealing and challenging prevailing beliefs and social practices

The Element of Transformation

1. Individual emancipation
2. Improvements in society
3. Improvements in social theories

The original theoretical work on 'researcher perspective', on which my current paper is based, is appropriately framed within a critical theory research design. The paper whose rejection stimulated these Notes, on the other hand, uses content analysis to apply that theory to a set of papers in a new and potentially very important research domain. The notions discussed in this section are therefore of general relevance to the establishment of a satisfactory content analysis research design, but do not directly address the issues that I am confronting.

8 The Recognition and Critiquing of Ideological Assumptions

Although the references discussed above are of relevance to the problem, they fell short of the need. Two particular sources appeared to provide an appropriate foundation for content analysis of the kind that my research project undertakes. One is an approach to

literature review, and the other an approach to content analysis that the authors in question refer to as 'Critical Discourse Analysis'.

8.1 A Hermeneutic Approach for Conducting Literature Reviews

It has been argued that the emphasis on 'systematic' literature reviews noted in s.4.3 above "suppresses aspects of quality in research and scholarship that are at least as important as clarity, countability and accountability – such as intertextual connectivity, critique, interest, expertise, independence, tacit knowledge, chance encounters with new ideas, and dialogic interactions between researcher, 'literature' and 'data'" (MacLure 2005, p.394).

In Boell & Cecez-Kecmanovic (2014) it is argued that a constructively loose and iterative process is needed, to avoid undue constraints and unlock insight and creativity: "Highly structured approaches downplay the importance of reading and dialogical interaction between the literature and the researcher; continuing interpretation and questioning; critical assessment and imagination; argument development and writing – all highly intellectual and creative activities, seeking originality rather than replicability [MacLure, 2005, Hart, 1998]" (p.258, emphasis added).

The authors "propose hermeneutic philosophy as a theoretical foundation and a methodological approach for studying literature reviews as inherently interpretive processes in which a reader engages in ever exp[a]nding and deepening understanding of a relevant body of literature. Hermeneutics does not assume that correct or ultimate understanding can be achieved, but instead is interested in the process of developing understanding" (p.259). The framework, reproduced in Figure 2, comprises two intertwined cycles: a search and acquisition circle, and a wider analysis and interpretation circle (p.263).

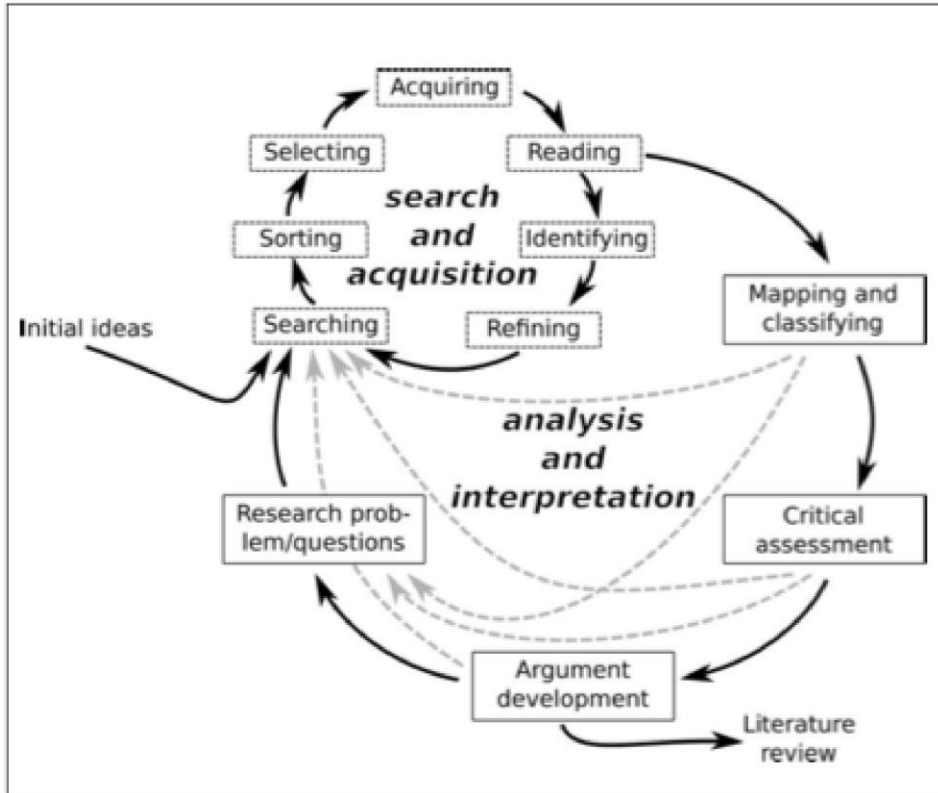


Figure 2: A hermeneutic framework for the literature review process From Boell & Cecez-Kecmanovic (2014)

The authors perceive the mapping and classification of literature as being "a creative process that builds on a deeper understanding of the body of literature achieved through analytical reading. This process may lead to new questions and identify new relevant publications to be included in the body of knowledge" (p.267). The approach embodies "questioning and critical assessment ... of previous research" (p.258), and analysis of "connections and disconnections, explicit or hidden contradictions, and missing explanations" and thereby the identification or construction of "white spots or gaps" (p.267, emphasis added).

"A critical assessment of the body of literature ... demonstrates that literature is incomplete, that certain aspects/phenomena are overlooked, that research results are inconclusive or contradictory, and that knowledge related to the targeted problem is in some ways inadequate [Alvesson and S[an]dberg, 2011]. Critical assessment, in other words, not only reveals but also, and more importantly, challenges the horizon of possible

meanings and understanding of the problem and the established body of knowledge" (p.267).

8.2 Critical Discourse Analysis

Wall et al. (2015) proposes an approach to content analysis that the authors refer to as 'Critical Discourse Analysis'. Their starting-point is that "the information systems (IS) discipline is subject to ideological hegemony" (p.258). They see this as being harmful, and they argue that "review papers can ... challenge ideological assumptions by critically assessing taken-for-granted assumptions" (p.257).

They explain the idea of 'ideological hegemony' as being "the conscious or unconscious domination of the thought patterns and worldviews of a discipline or subdiscipline that become ingrained in the epistemological beliefs and theoretical assumptions embedded in scientific discourse (Fleck, 1979; Foucault, 1970; Kuhn, 2012). In academic literature, a hegemony may manifest as common framing of research topics and research questions, the domination of theories and research methods that carry similar assumptions, common beliefs about what constitutes the acceptable application of research methods, and common beliefs about how research results should be interpreted.

"By ideology, we mean those aspects of a worldview that are often taken for granted and that disadvantage some and advantage others. Ideologies are not falsehoods in an empirical sense, but are a constitutive part of researchers' and research communities' worldview ... that are removed from scrutiny (Freeden, 2003; Hawkes, 2003). Thus, ideologies can be harmful to individuals who are disadvantaged or marginalized by them, and they can be problematic to scientific research because they represent blind spots" (p.258, emphases added).

Wall et al. proposes that a critical review method "based on Habermasian strains of critical discourse analysis (CDA) (Cukier, Ngwenyama, Bauer, & Middleton, 2009; Habermas, 1984)" (p.259) can overcome the limitations of working only within ideological assumptions. CDA "examines more than just a communicative utterance. Foucauldian analysis also examines the context in which an utterance was uttered by assessing power relationships between actors and the structures and processes that guide behavior and constrain the development of knowledge (Kelly, 1994; Stahl, 2008)" (p.261, emphasis added).

The process involves the assessment of "violations of four validity claims" (p.261):

1. the communication's comprehensibility, by which the authors mean "technical and linguistic clarity of communication (Cukier et al., 2009, p. 179)"
2. the communication's truthfulness, which "refers to the propositional content of communication as represented by complete arguments and unbiased assertions (Cukier et al., 2009; Habermas, 1984)"

3. the communication's legitimacy, which "refers to the representation of different perspectives; all perspectives should be heard and considered (Cukier et al., 2009; Habermas, 1984)" (emphasis added)
4. the speaker's sincerity, which refers to the correspondence between what a speaker says and what the speaker actually intends by the communicative utterance (Cukier et al., 2009; Habermas, 1984). It is difficult to assess sincerity when a speaker is engaged in unconscious hegemonic participation because the speaker is operating on taken-for-granted beliefs and assumptions. When studying unconscious hegemonic participation, researchers should examine the sincerity of the larger community, which may dominate individual researchers' worldviews. This examination can be accomplished by examining common metaphor, hyperbole, and connotative language used across discursive utterances (i.e., research publications) (Cukier et al., 2009)" (emphasis added)

The authors identify four principles (pp.263-4):

1. Assume that the Publication Process Models the Ideal Speech Situation
2. Assume that Hegemonic Participation is Unconscious
3. Test all Publications for each Validity Claim
4. Conduct Reviews Within and Across IS Subdisciplines

They propose a seven-step process (pp. 265-9):

1. Identifying the Problem
2. Specifying the Literature
3. Developing Codes for Validity Claims
4. Analyzing Content and Coding
5. Reading and Interpreting
6. Explaining the Findings
7. Engaging in Critical Reflexivity

The hermeneutic approach to literature review and the CDA approach to content analysis, overlaid on the prior literature, enable the design of a content analysis research method with the desired attributes. That research method has a good fit with theory developed using critical theory research. It prioritises depth of insight over narrow, positivist quantification. It encourages the analyst to focus on key validity claims and the hidden assumptions within the text under study. It forces the researcher to confront, and to take into account, their own ideology and agenda. It pushes the researcher in the direction of critique for the purposes of theory construction or re-construction, rather than criticism for its own sake.

9 Application of the Research Findings

The preceding sections provide a basis for adapting the research method for my research project. The most significant implications for my work, reflected in Annex 2, were as follows:

- It is necessary to convey more clearly that 'researcher perspective' theory is a product of critical theory research, that it has a "focus ... on the power structures that lie behind accepted interpretations", that it "takes a value position" (Myers & Klein 2011, p.24), that it "demonstrates ... that certain aspects/phenomena are overlooked" (Alvesson and Sandberg, 2011), and that it sets out to "challenge ideological assumptions by critically assessing taken-for-granted assumptions" (Wall et al. 2015, p.257) – and that it is accordingly necessary for the content analysis to identify the elements of existing works that reflect the existing power structures
- The iterative nature of Boell & Cecez-Kecmanovic (2014)'s hermeneutic approach for conducting literature reviews provides a clear explanation of the need for repetitive loops and introspective questioning by the researcher about their analysis and interpretation of the works. This is reflected in step 7 of the revised process in Annex 2
- The distinction between preliminary 'orientational reading' and deep 'analytical reading' (Boell & Cecez-Kecmanovic 2014, p.267) can be used to explain how confidence is gained in the appropriateness of the selection, coding and interpretation of passages in each work. This is reflected in steps 1 and 3 of the revised process in Annex 2
- The research method needs to be expressly described as directed content analysis using a priori coding, as described by Hsieh & Shannon (2005, p.1277). However, greater efforts may be needed to "introduce some quantification [such as] frequency analysis" (King & He 2005, p.667), and "tabular, graphical, or pictorial presentations" (Boell & Cecez-Kecmanovic 2014, p.266), in order to upgrade from a 'narrative content analysis' to 'descriptive content analysis'. This is reflected generally, and particularly in step 6 of the revised process in Annex 2
- Greater efforts may be needed to convey the means whereby reliability is achieved in selection, coding and interpretation activities, in line with Krippendorff (1980), Weber (1990) and Stemler (2001)
- Stress needs to be placed on the third of Wall et al. (2015)'s four validity claims. My proposition is that the papers in the Special Issue are 'violations of the communication's legitimacy', because they do not represent all stakeholder perspectives, but only the interests of a single stakeholder
- Care is needed to avoid attributing intent on the part of authors whose papers are criticised, and instead the analysis should "assume that hegemonic participation is unconscious" (Wall et al. 2015, pp.261, 263-4). This is reflected in step 7 of the revised process in Annex 2

10 Conclusions

This paper has reported on the results of a study of meta-questions affecting a content analysis project. A range of guidance has been located and summarised in relation to secondary research whose raw data is published academic papers. The role of criticism (or critiquing) in IS research has been clarified. The particular challenge has been confronted of how to perform content analysis when the theory-lens through which the observation is being performed arises from critical theory research.

The primary purpose of the work has been fulfilled, in that the process specification for the analysis of the relevant papers has been adapted in order to better reflect existing theory relating to content analysis of published works, particularly in a critical theory context. Further, a set of changes to the research method section has been identified, which have implications for the interpretation of the papers and the expression of the critique. In addition, guidance has been assembled on how to, and how not to, communicate the results.

This paper has implications for IS researchers generally. Much of the material that has been summarised applies to all content analysis of published papers, nomatter whether the research approach adopted is positivist, interpretivist, design science or critical theory. A small qualification is appropriate, in that the majority of the material relates to research that goes beyond mere exposition of existing literature and is at least modestly questioning about that literature's quality and/or continuing relevance.

This paper goes further, however, in that it contains guidance in relation to constructive criticism of existing works. I contend that IS will become increasingly static, and its outputs will be decreasingly valuable, if it values politeness to authors too highly and puts too little emphasis on constructive criticism of existing literature. The method adopted includes proposals about how a researcher can detect and avoid excessively sharp expression, focus the discussion on the message, avoid shooting the original messenger, and in turn avoid being shot themselves.

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Annexes

- 1 The Process Specification for the Textual Analysis of the Papers
<http://www.rogerclarke.com/SOS/PDMP-Process.pdf>
- 2 The Revised Process Specification for the Content Analysis of the Papers
<http://www.rogerclarke.com/SOS/PDMP-Process-Rev.pdf>
- 3 Content Analysis Exemplars in the IS Discipline

<http://www.rogerclarke.com/SOS/CACT.html#CAE>

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The Impact of Cloud-Based Digital Transformation on ICT Service Providers' Strategies

TREVOR CLOHESSY, THOMAS ACTON & LORRAINE MORGAN

Abstract The relationship between digital transformation and strategy formulation in the context of new digital technologies is emerging as a research area which is ripe for investigation. Recently, information system researchers have focused their attention on exploring this relationship in the context of cloud computing-based digital transformation. However, while extant research has explored this relationship from an adopter perspective, there is a dearth of research which has used an information and communications technology (ICT) service provision viewpoint. Taking the perspective of fifteen ICT service providers, this comparative case study elucidates how cloud-based digital transformation has impacted these organisations' strategy formulation processes. This paper provides the following insights. First, cloud-based digital transformation can positively impact the realisation of strategic objectives in terms of deliberate strategies such as agility and competitive positioning. Second, we present a process model which delineates how ICT service providers' strategy formulation was observed to be an emergent process, encompassing recursive cycles of business model experimentation and iteration, organisational learning and organisational adaptation, primarily as a result of the profound disruptive and innovative impact of cloud-based digital transformation.

Keywords: • Digital Transformation • Cloud Computing • Strategy • Case study • ICT service provider •

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1 Introduction

In recent years organisations have realigned their information and communications technology (ICT) strategic objectives to provisioning and/or sourcing lower cost, flexible, resilient supply and delivery options as a means of responding to the impacts of globalisation and the associated cost pressures (Mohdzain and Ward 2007). Cloud computing represents an innovative technological advancement which appears to offer a solution to these aforementioned objectives (Ward, 2012; Iyer and Henderson, 2012). Subsequently, incumbent organisations are undergoing cloud-based digital transformation journeys in order to reap the multitude of anecdotal business and strategic benefits. In order for organisations to perform effectively in a digitized and networked economy, an “understanding of the role and relevance of strategy is necessary for effective competitive behaviour” (Mansfield and Fourie, 2004). The role of ICT in developing effective strategies has been well documented (Porter and Millar, 1985; Henderson and Venkatraman, 1993; Atkins, 1994). Strategic ICT can not only support and shape strategy but can also be pivotal in determining commercial viability and represent a source of competitive advantage when used in innovative ways (Croteau and Bergeron, 2001; Zott et al., 2011). However, the concept of ICT-enabled strategy formulation is relatively ambiguous. For instance, Ward (2012) opines that the “knowledge we have developed [over the past 30 years] about information systems strategies appears to have had little impact in some organisations, even though they invest hundreds of millions of pounds in new information systems and digital technology every year. This is evidenced by a global survey conducted by McKinsey (Khan and Sikes, 2013) of 807 executives which revealed that while they acknowledged the strategic importance of digital technologies to their business goes beyond cutting costs (e.g. business efficiency, product and service innovation, entering new markets and so on), they were also dissatisfied with its effectiveness pertaining to enabling overall strategic objectives (e.g. the realisation of forward looking strategies which support growth and innovation). In the context of cloud computing, strategy can be defined as “a set of decisions required to create and deploy a network-based, information service delivery strategy that results in both cost savings and organisational agility (Iyer and Henderson, 2010). However, the current state of art pertaining to cloud-based digital transformation strategies that might be appropriate for ICT service providers is relatively ambiguous. As ICT service providers begin to formulate their cloud strategies, “they need to understand the inherent capabilities that are afforded by cloud computing...[which] can help them gain a competitive advantage by creating opportunities for cost advantage and organisational agility”(Iyer and Henderson, 2010). Having a comprehensive understanding of cloud-based digital transformation is “critical to forming a cloud strategy that will unlock business value worth orders of magnitude more than the costs” (Linthicum, 2012). ICT are strategic insofar as they successfully implemented and are also used to realise strategic intent (Arvidsson, Holmström, and Lyytinen, 2014). For instance, Khanagha et al. (2014) conducted a longitudinal qualitative case study, from 2009 to 2013, of a telecommunication company (Telco) in order to investigate how an established firm organised their digital transformation and strategic arrangements when

transitioning to provisioning cloud services. The authors identified that as a result of the emergence of disruptive cloud-based digital transformation, the strategy formation process encompasses a “collective experimental learning process revolving around a number of alternative strategic intentions ranging from incremental evolution and transformation to complete replacement of the existing business model” (Khanagha et al., 2014). Currently, there is a dearth of research relating to how cloud-based digital transformation impacts ICT service providers' strategies. Consequently, research relating to how these concepts develop, interact and harmonise is also underdeveloped. This is pertinent now as the cloud computing paradigm has reached a level of maturity which lays the foundation for IS researchers to investigate how ICT service providers have moulded and sustained their cloud-based digital transformation arrangements (Clohessy et al. 2016, Hess et al. 2016). In order to ensure the long-term business viability and sustainability of the cloud computing paradigm, further research is required to elucidate exemplars of successful and unsuccessful ICT service provider digital transformation arrangements (Chang et al., 2013).

Thus, the objective of this research is to:

Explore how cloud-based digital transformation impacts ICT service providers' strategies?

The remainder of the paper is structured as follows: The next section builds the theoretical foundation for the study. Then we elucidate our research method. Next, the findings are presented and discussed. Finally, we conclude with implications for theory and practice.

2 Theoretical Underpinning

2.1 Cloud-Based Digital Transformation

Digital transformation is concerned with “the changes digital technologies can bring about in a company's business model, which result in changed products or organisational structures or automation of processes” (Hess et al. 2016). The long journey towards digital transformation is often fraught with complexity and ambiguity for incumbent ICT firms (Clohessy et al. 2017). This is compounded by the fact that the transformation of mature business models to digital-based business models encompasses potential nuanced legacy liabilities and issues. This is prominently evidenced by ICT service provider stalwarts such as Dell, Intel, IBM and Hewlett Packard whose struggles pertaining to how to best leverage the benefits of cloud-based digital transformation have been well documented. Frequently, these organisations are operating in uncharted digital waters and as a consequence lack the strategic clarity pertaining to what steps they need to consider prior to and during their digital transformation journey. The cloud computing concept encompasses a recombination of existing and new technologies and differentiates itself from antecedent ICT paradigms via five essential characteristics: rapid elasticity,

measured service, broad network access, resource pooling, and on-demand-self-service (Mell and Grance 2011). Cloud computing enables ICT service providers (person, organisation or entity responsible for making a service available to cloud consumers) to virtualise their computational resources and concurrently provision them, via a service orchestration process, typically in the form of Software-as-a-Service (SaaS), Platform-as-a-Service (PaaS) or Infrastructure-as-a-Service (IaaS) (Liu et al., 2011). While there is anecdotal evidence which highlights the transformative business and strategic value afforded by cloud computing for ICT service providers (Clohessy et al., 2016, Armbrust et al., 2009), our understanding of how these organisations can develop digital transformation strategies that effectively align with the value propositions inherent to cloud computing technologies is still limited (Iyer and Henderson, 2012; Chang, Walters and Wills, 2013; Khanagha et al., 2014).

2.2 Bounding the Concept of Strategy

In order for IS researchers to have a comprehensive understanding of an organisation's ICT strategy, it is useful to understand the evolution of their intended and realised strategies (Chan, Huff and Copeland, 1998). Mintzberg and Waters (1985) propose a widely cited comprehensive categorization for strategy which identifies intended, realised, deliberate, unrealised and emergent strategy as constituting key components of the strategy formulation process. This categorization of strategy is suitable for investigating the “peculiarities” of modern emerging ICT (Peppard, Galliers, and Thorogood, 2014) and thus provides a backdrop for this study to better explore the strategy formulation process of ICT service providers (Figure 1). Intended strategy represents the organisation's official strategy (which may or not be written down) and realised strategy which reflects the outcomes of decisions undertaken by the organisation stakeholders which may manifest from deliberate, emergent, and unrealised strategies. Deliberate strategy is defined simply as “realised as intended”, emergent strategy as “patterns or consistencies realised despite, or in the absence of, intentions” and finally unrealised strategy as “intentions that are unsuccessful in its consequences” (Mintzberg and Waters, 1985).

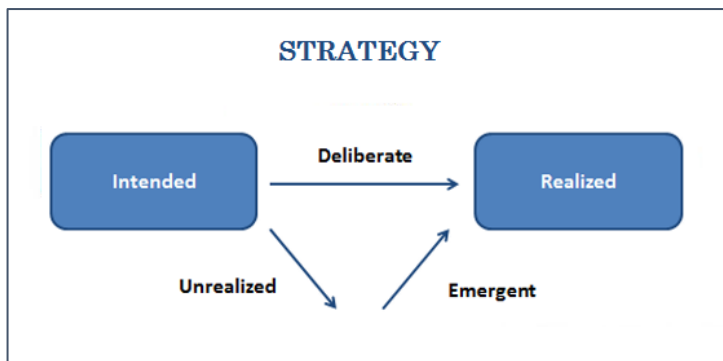


Figure 1: Strategy Research Lens (Mintzberg and Waters, 1985)

We selected the aforementioned seminal categorisation as a basis for conceptualising the concept of strategy for the following reasons. First, no single strategy can be a panacea for an organisation and that the most optimal strategic variables alter due to certain conditions and factors (Zott and Amit, 2008). Given the rapidly evolving nature of the cloud computing paradigm (Ojala and Tyrvaïnen, 2011), and the subsequent dynamic nature of cloud-based digital transformation (Clohessy et al., 2016), the categorization is well suited for delineating the strategy formulation process and chronicling how ICT service providers have arrived at their current realised strategy. Second, in the context of cloud-based digital transformation, the categorisation enables the identification of problematic issues and emerging patterns of events and behaviours which may have resulted in ICT service providers deviating from their intended strategy (Mintzberg and Waters, 1985; Chan et al., 1998). Third, the categorisation enables business strategy to be “viewed in a non-descriptive manner, being conceived in terms of how companies actually decide and act, not how they should decide and act” (Jansson, 2008). In the next section, we delineate the research method operationalised in order to elucidate our research objective.

3 Methodology

This paper’s research objective is to explore how cloud-based digital transformation impacts ICT service providers’ strategies? Due to the dearth of empirical research pertaining to examining the relationships of the focal phenomena under scrutiny, our study is exploratory. Thus, a multi-method, comparative case study research design was selected for the study (Stebbins, 2001, Yin, 2014). The research sampling approach was directed by evolving theoretical concepts, whereby we identified organisations and people from which we expected to elicit the majority of insights into the phenomena of interest (Strauss and Corbin, 1998). For instance, this study encompasses an analysis of both large and small and medium enterprise (SME) ICT service provider firms. The large business model mature (BMM) ICT ventures represent organisations that have significantly longer tenure as ICT service providers that are currently transitioning from ‘pre-cloud’ to ‘cloud-based’ business models. The SME born-on-the-cloud (BOC) ICT ventures represent organisations who do not possess the requisite existing maturity or tenure of pre-cloud business models. These firm’s business models originated on the cloud. Data collection took place between January 2015 and August 2015 using semi-structured interviewing based on a common protocol across 15 ICT service provider organisations. Following the standard practice of using senior management as data sources, (Iyer and Henderson, 2012, Clohessy et al., 2016) we chose a senior manager from each targeted organisation. Interviews lasted between 70 and 120 minutes. The interviews (including follow-up interviews) were conducted until theme exhaustiveness was reached, which manifested when similar themes were being identified and no new themes emerged. All interviews were transcribed, proof read and annotated and then coded using NVivo 10. In order to improve the credibility of the data and provide cross and complementary perspectives on emerging elements, secondary evidence in the form of archival documents and published materials sourced from the ICT service providers’

websites (e.g. white papers, specific ICT service providers case studies, brochures, reports) were collated and analysed. While the study did not undertake a grounded theory approach, in analysing the data, the researcher used an analytical hierarchical data analysis process adopted from Ritchie, Spencer and O'Connor (2003) incorporating open and axial coding techniques based on the recommendations of Strauss and Corbin (1998).

Table 1: Data sources for the study.

ICT provider*	Size**	Cloud Services/Business Model***	Interviewee
<i>Inno Ltd.</i>	Large	<ul style="list-style-type: none"> ▪ Hybrid, public and private managed and self-service hosting cloud offerings. ▪ Outsourcing and consultancy services. (BMM) 	Cloud CTO
<i>MobCon</i>	Large	<ul style="list-style-type: none"> ▪ Provision connectivity into cloud IT solutions via their existing next generation Telco network and bespoke software solutions. ▪ Manage the design, build and implementation of their customers cloud solution ensuring seamless network integration. (BMM) 	Cloud CTO
<i>Sigmaten Systems</i>	Large	<ul style="list-style-type: none"> ▪ Hybrid, public and private managed and self-service hosting cloud offerings. ▪ Outsourcing and consultancy services. ▪ Microsoft and SAP value added resellers. (BMM) 	Cloud CTO
<i>Gaviour Ltd.</i>	Large	<ul style="list-style-type: none"> ▪ Hybrid, public and private managed and self-service hosting cloud offerings. ▪ Outsourcing and consultancy services. (BMM) 	Cloud Manager
<i>ZystemTech</i>	Large	<ul style="list-style-type: none"> ▪ Hybrid, public and private managed and self-service hosting cloud offerings. ▪ Outsourcing and consultancy services. (BMM) 	Cloud Manager
<i>SandstemTech</i>	SME	Bespoke software solutions enable travel companies to derive maximum benefit for their customers. (BOC)	CTO
<i>Levatte</i>	SME	▪ Bespoke procurement software solution.	Cloud Manager

		<ul style="list-style-type: none"> ▪ Enables customers to source and evaluate new suppliers. 	
<i>Yet3</i>	SME	Bespoke CRM sales management and membership body software solutions. (BOC)	CEO
<i>FieldZuite</i>	SME	<ul style="list-style-type: none"> ▪ Supply IT infrastructure in the form of public, private and hybrid cloud infrastructure hosting. ▪ Disaster recovery and virtual desktop services. (BOC) 	CEO
<i>VClazz</i>	SME	<ul style="list-style-type: none"> ▪ Supply IT infrastructure in the form of public, private and hybrid cloud infrastructure hosting. ▪ Microsoft value added resellers. (BOC) 	CTO
<i>Zeta2k</i>	SME	Bespoke software solution enables customers to visualize their raw log data in order to unlock real time critical insights. (BOC)	CTO
<i>Med3Care</i>	SME	Bespoke software solutions aimed at the travel clinic service market segment. (BOC)	CEO
<i>Braavos PLC</i>	SME	Bespoke software solution enables customers to integrate and connect their existing core IT infrastructure into an ICT service providers’ offering. (BOC)	CEO
<i>LYS</i>	SME	<ul style="list-style-type: none"> ▪ Supply IT infrastructure in the form of private and hybrid cloud infrastructure managed hosting. ▪ Outsourcing and consultancy services. ▪ Microsoft and Citrix value added resellers. (BOC) 	CIO
<i>WebReve</i>	SME	Bespoke software solution enables customers to design and build cloud-based website solutions. (BOC)	CEO

Company pseudonyms have been applied to protect anonymity. ** Firm size categorised using limits as set by the European Union along the dimensions “number of employees” (e.g. Small 10 -49, Medium 50-249, Large 250+) and “annual turnover”. *Large firms categorised as ‘business model mature’ (BMM) ventures (e.g. extant pre-cloud business models) while SME firms categorised as “born-on-the cloud” (BOC) business model ventures (e.g. current business model originated on cloud).*

4 Findings

In this section, we report the empirical results obtained during the analysis of the semi-structured interviews (denoted as sanitised quotes), archival documentation and published materials. It was evident from the study that cloud-based digital transformation not only have a dynamic and turbulent impact on ICT service providers' strategies (emergent and unrealised) but also have a cogent collective impact in terms of agility and competitive positioning (that is, their deliberate strategy) (see Table 2).

Table 2: The impact of cloud computing based digital transformation on realised strategy

Realised Strategy	Digital Transformation Impact	Sources
Deliberate Strategy	1. Increased agility - organisational and operational	All ICT service providers - Examples from INNO, Zeta2k, FieldZuite, MobCon, LYS, Braavos, SandstemTech
	2. Increased strategic acquisitions	All large ICT service providers - Examples from Sigmathen Systems, INNO
Emergent and Unrealised Strategy	3. Increased strategic partnerships	All ICT service providers - Examples from MobCon, Zeta2k, LYS, VClazz, INNO, Med3Care
	4. The dynamic nature of cloud-based digital transformation, in conjunction with the fluid of the cloud computing market, facilitates increased incidences of emergent and unrealised strategy.	All ICT service providers- Examples from VClazz, Yet3, FieldZuite, MobCon, INNO

The strategies for ICT service providers (large and SME) encompassed short and long-term objectives such as cogent market impact, increasing return on investment (ROI), enhanced agility, reinvestment of capital, and reducing capex and opex. For example, study participants in Levatte and Sigmathen Systems described how their strategy is focused on broadening their cloud geographic footprint and growing their customer base in order to increase revenues while the CEO at FieldZuite explained that their primary strategy is about increasing revenues through repeat customers.

All ICT service providers confirmed that their cloud-based business model(s) have significantly impacted the realisation of their company's strategic objectives (see Table 2) which has been largely the cumulative result of a combination of deliberate, emergent and unrealised strategy. In terms of deliberate strategy, all ICT service providers identified that their main objective for operationalising cloud influenced business models was mainly for agility reasons. For instance, the CTO at INNO described how their cloud strategy was focused on enhancing the agility of the organisation, stating that "the new religion is cloud and we are all about agility and DevOps principals. Our objective is to develop new or improved services faster than we did in the past. All new offerings must be agile and be able to be provisioned at low cost". This CTO further elucidated that "our new strategy is that we are going to become a SaaS organisation and get out of the hardware business". The CEO at Braavos pointed out that their cloud-based business models "foster agile and cost effective operations which are currently enabling our strategic objectives of becoming a market leader as a cloud integration service provider". While the CTO at Zeta2k described how their "cloud enabled business model has allowed us to be very agile and nimble in order to provide a service to a large number of users very quickly, thus facilitating strategic objectives". Similarly, the CTO in FieldZuite explained that their business model has had a significant collective impact on the company's strategic objectives by not only enabling them to compete with larger ICT service providers but also to deliver their cloud services with greater efficiency to multiple global locations around the world. Moreover, the CTO in MobCon elucidated on two examples of the cloud business model impact on their strategic objectives.

First, he described how cloud computing facilitates enhanced efficiency (e.g. operational, cost and resource) and faster innovation in terms of supporting accelerated cycles of development. For example, cloud computing enables the early deployment of demonstration environments that would otherwise require substantial capital expenditure as a precursor to a full business case. Second, MobCon's strategic partnering with Amazon Web Services (AWS) facilitated stability in their business model components, thus minimising strategy-business model misalignment issues which may have manifested because of the disruptive nature of cloud computing technology. The CTO in SandstemTech added, "the cloud has enabled us to be more responsive. We have sales pitch for a large airline next week and cloud computing has enabled us to create an enterprise demo environment for them in a matter of hours. The traditional method we would have utilised three years ago would have taken weeks in order to create the same infrastructure for the demo environment". Strategic acquisitions were also identified as deliberate strategy by all large ICT service providers. For example, the CTO in Sigmathen Systems explained, "it was a deliberate strategic decision to acquire an established managed hosting in ACD (company synonym)". Prior to this acquisition, the company were losing customers to public cloud offerings. In order to streamline the on-boarding process for cloud customers, the company also acquired an independent software vendor (ISV) start-up company who specialised in subscription billing.

The CTO in INNO also pointed out that their decision to acquire an established cloud provider such as CEES was pivotal to their cloud success, stating that “INNO’s acquisition of CEES in 2013 accelerated its cloud computing strategy overnight. We can now use the CEES infrastructure and platform to rapidly deploy existing software services as SaaS”. Partnerships were also identified as an example of deliberate strategy by ICT service providers (e.g. Zeta2k, LYS, VClazz, INNO, Med3Care). Both the interviewees in LYS and VClazz confirmed that it was a deliberate decision for their organisations to operate as value added resellers (VARs) in order to avail of the economies of scale provided by their large ICT service provider partner. All ICT service providers confirmed that their emergent strategy manifested from cloud enabled accelerated rate of business growth and incidences of unrealised strategy. For instance, the CTO in VClazz opined, “as a result of the exponential rate of growth we have experienced provisioning cloud services, we have successfully transitioned from the end-user market to the channel markets”. Similarly, the CEO in Yet3 pointed out that the company’s current realised strategy has manifested as a result of emergent strategy based on their accelerated growth in niche global target markets. In relation to unrealised strategy, IaaS was provided as an example by ICT service providers (e.g. MobCon, FieldZuite, INNO). For example, the CTO in INNO explained how prior to acquiring CEES, their efforts to build their own IaaS proved vexatious, further describing how “it really was a painful process trying to develop our own bespoke IaaS. It didn’t have the scale of AWS, Rackspace, and Azure. It failed simply as there wasn’t a big enough pool of resources for all the customer requirements we had. We did not invest in it aggressively enough and were far too conservative about investing in it”. The CTO in MobCon described how the company were initially going to build their own cloud infrastructure. However, MobCon decided to partner with AWS, a partnership that enabled the company to accelerate its move to provide cloud services to its existing customers.

The study identified that the dynamic and recursive nature of ICT service providers’ strategy formulation, business model experimentation, organisational learning and subsequent adaptation when attempting to explore disruptive and/or innovative cloud business models. Figure 2 below depicts the process model we have developed to reflect this recursive process. All ICT service providers confirmed that their cloud strategy formulation and review decisions were largely management-led (e.g. board of management, investors and so on) with changes being dictated by business model(s) component performance (e.g. market analysis, revenue, cost). For example, the CTO at Zeta2k surmised, “our organisation’s strategy is management-led and informed by business model performance, strategic roadmaps, whitepapers, analyst research reports and customer communities’ feedback”, while the CTO at INNO explained how they have a committee of fourteen people responsible for developing corporate strategy for the company’s four divisions (that is, hardware, software, business consulting and technology consulting). However, on the contrary, the CEO at Yet3 described how their strategy is more leadership-led, which is facilitated by the flat structure of the organisation. The CEO elucidated, “while the advisory board help the company to see the forest from the trees, we have employees in Israel, Vietnam and Japan who can influence

strategic decisions without ever having met the CEO or the advisory board as they know more about the lay of the land than we do”. The CEO asserted that the ability of their globally distributed employees to provide strategic insight on their national landscapes has been a cornerstone of the company’s continued success.

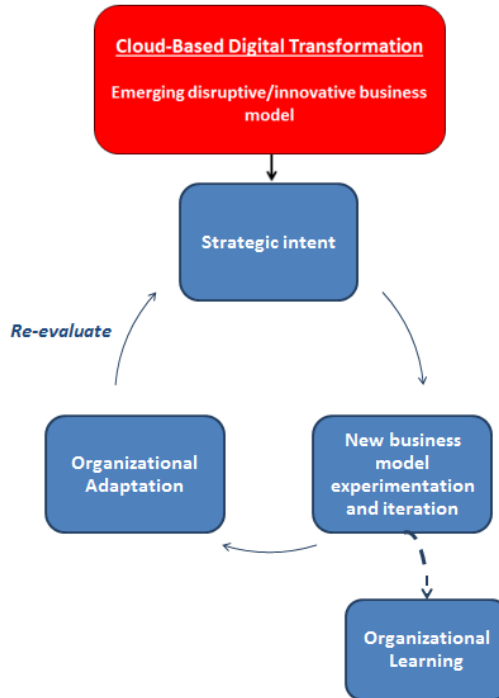


Figure 2: The relationships among strategy formulation, business model experimentation and organisational adaptation when exploring an emerging disruptive and/or innovative business model

In an effort to maximise the realisation of their strategic intent, all ICT service providers are engaging in business model experimentation and iteration. For example, the cloud manager at Levatte described how they are experimenting and iterating their business model constructs at varying levels within the organisation. The CTO in INNO also explained how their organisation was utilizing a bespoke component business modelling (CBM) technique for formalising and reviewing their product business models. The CBM technique breaks an enterprise down into its constituent segments and enables INNO to take the aforementioned areas and break them down and identify elements which bring business value to the company. The CTO at INNO further elaborated, “the CBM breaks our IT function down into segments which we do that is strategic and operational and tactical. Elements and segments which are important for our operations are maintained whilst other which are not strategically important are outsourced”. The CEO at FieldZuite

also explained how the business model impact of the cloud computing paradigm was different to antecedent technologies, pointing out that “customer needs are constantly changing. An inability to review and change individual business model components can result in detrimental effects to the longevity of a ICT service providers’ business”. While the CTO at Sigmathen Systems explained that transition for traditional hardware and software providers to more cloud focused provision methods has had a combined revolutionary and chaotic impact on their business model. The study found that the learning accumulated from this iterative business model process serves as a foundation for organisational adaptation based on the potential, requirements and impacts of the new cloud business model. Strategic organisational adaptation encompassed re-structuring, re-organisation, change of personnel and new ways of managing.

The outcomes of this organisational adaptation served as an input for re-evaluating the strategic intent of the organisations. Our analysis complements and extends existing research - in particular Khanagha et al., (2014). On the one hand, it confirms the dynamic nature of ICT service providers’ strategic intent in response to disruptive cloud-based digital transformation and also identifies the salient roles of adaptation, business model experimentation and the resulting accrument of new knowledge. However, on the other hand, contrary to their findings that presented structural adaptation as a precursor to business model experimentation, our findings indicate that business model experimentation and iteration and the subsequent derived organisational learning serve as salient inputs to ICT service providers evaluating whether the level of organisational adaptation required to pursue their strategic intent is feasible. This would suggest that ICT service providers are operationalizing a cautionary and evolutionary approach prior to committing substantial finances and resources to restructuring their organisation in order to realise their strategic intent. In the next section, we conclude with implications for research and practice.

5 Implications for Theory and Practice

The objective of this study was to conduct an exploratory investigation into how cloud-based digital transformation impacts ICT service providers’ strategies? Both theoretical and practice contributions stem from this research. From a theory perspective, extant empirical research in the area of cloud-based digital transformation has largely focused on adopter perspectives. This study provides a contribution towards a vivid contextual understanding the broader impact of cloud-based digital transformation on both large multinational and SME ICT service providers’ strategies using Mintzberg and Waters’ (1985) seminal research lens. Moreover, our study can further be considered revelatory in that we have incorporated our findings into a new process model (see Figure 2) which demonstrates that business model experimentation and organisational learning serve as salient moderating antecedents to determining the level of organisational adaptation that may be required to realise strategic intent of a cloud-based digital transformation. From a practice perspective, our findings suggest that ICT service providers should continue to focus on using business model experimentation as a means for harmonizing their

organisation's strategies with the disruptive and/or innovative idiosyncrasies of cloud-based digital transformation. While the comparative case study proved to be rich in detail, the findings are based on a small purposeful sample of fifteen firms. Thus, this study is naturally limited in terms of its generalisability. However, we took care in relating our research findings in order to relate the idiographic details of the cases to theoretical concepts.

Given the exploratory nature of this research and the high-level nature of the new process model, others will need to build theory and subsequently test it. From an organisational learning perspective, future research is warranted from a resource-based view of the firm and dynamic capabilities perspectives in order to explore how successful ICT service providers are exploiting their core resources and competencies in order to take advantage of the opportunities afforded by cloud technology. Additionally, a systems thinking approach could elucidate the implications of altering existing complex relationships, processes, and feedback mechanisms. For example, different change processes may conflict with one another (e.g. there may be potential interference between re-structuring and individual learning). Finally, while the primary objective of this study was to examine the broader impact of cloud-based digital transformation on the strategy formulation process, we believe that studying the strategy archetypes which emerge as a consequence of explicit cloud-based service models (e.g. SaaS, PaaS, IaaS) seems an area ripe for research.

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Decision Makers and Criteria for Patient Discharge - A Qualitative Study

ISABELLA EIGNER, ANDREAS HAMPER, NILMINI WICKRAMASINGHE &
FREIMUT BODENDORF

Abstract The decision to discharge a patient involves multiple stakeholders and criteria that need to be considered during this process. This paper aims at identifying the issues, behaviours, and needs for patient discharge with regards to the risk of readmission and the available information in that process using a qualitative approach. For this purpose, focus groups are conducted at an Australian not-for-profit tertiary hospital group and analysed according to three main areas: Decision makers and factors influencing the time of patient discharge, the risk of unplanned readmission and available information. The results of the focus groups indicate the complexity of admission and initial diagnosis as influencing factors and consequences of the time of patient discharge and suggest requirements on how to include this knowledge into future decision making using data analytics.

Keywords: • Patient discharge • length of stay • risk of readmission • focus group • decision support • data analytics •

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1 Introduction

The decision whether or not to discharge a patient is one of the most frequent and complex decisions of clinicians (Harun, Salek, Piguët, & Finlay, 2014). It involves a multidisciplinary team and careful evaluation of several medical and non-medical factors to determine the best time to send a patient home. According to Armitage (1981), “the discharge of medical patients consists often not of a single event but of a lengthy process of negotiation involving professional staff, patients and their relatives” (Armitage, 1981). Thus, a variety of stakeholders and influencing factors are to be considered in this decision. While the implications and requirements of effective discharge planning have been analysed in various studies (Armitage & Kavanagh, 1998; Augustinsson & Petersson, 2015; Chadwick & Russell, 1989; Goncalves-Bradley, Lannin, Clemson, Cameron, & Shepperd, 2016; Mukotekwa & Carson, 2007), the specific time of patient discharge that leads to the best outcome has not yet been considered in detail (Matis, Farris, McAllister, Dunavan, & Snider, 2015). Finding the optimal time of discharge can lead to fewer unnecessary readmissions, enable cost reductions and therefore allow for a better allocation of resources within the hospital. Therefore, this study focuses on the influencing factors that can determine the optimal time of patient discharge, both from a qualitative and cost perspective. For this purpose, involved stakeholders, as well as medical and non-medical criteria that are considered in the discharge decision, have to be identified. To specify the best outcome from a qualitative view, readmission rates are used as a comparative value. From a cost perspective, we utilize, patient length of stay (LOS) as the comparative indicator for the time of patient discharge, as this represents a common cost factor over time.

Hospital reimbursements are based on case rates, according to so-called diagnosis-related groups (DRG). For each DRG, a cost weight is set by the Department of Health that determines the reimbursement rate for the hospital for each episode within that DRG. To allow for different types of stay and moderate financial risk, the case mix model has been adapted to include cost weights for shorter or extended hospital stays. In Victoria, a “Weighted Inlier Equivalent Separation (WIES)” is used, where the DRG cost weight is adjusted for time spent in the hospital. Thus, the length of stay highly influences a hospital’s reimbursement rates (State Government of Victoria, Department of Health).

Figure 1 displays the development of costs and reimbursements over time. The cost curve includes all costs incurred for procedures, accommodation and maintenance costs. We assume that the curve flattens with increasing time, as cost-intensive procedures occur in the beginning and accommodation costs in the later stages of the stay. A balance of revenues and costs, i.e. the Break-Even-Point (BEP), for a DRG is assumed at the determined average length of stay for a single DRG. As a result, the shading to the left represents the profit zone (cf. Figure 1). For each additional day, the patient is hospitalized in the hospital, the hospital suffers losses. The actual cost curve is hospital-individual and can, therefore, deviate for each episode.

For a hospital, it would, therefore, seem most profitable to discharge a patient as soon as possible within the inlier range. However, if the patient is readmitted to the hospital for a related cause of the preceding episode, reimbursements can be suspended for the readmitted episode or other penalties might occur (Center for Medicare & Medicaid Services, 2016). Studies have shown that the length of stay has a potential impact on the quality of care and thus the potential risk of readmission of a patient (Baker, Einstadter, Husak, & Cebul, 2004; Heggstad, 2002). While some argue a longer length of stay to be beneficial (Bartel, Chan, & Kim, 2014), other studies show a negative effect with a longer length of stay on outcomes (Saczynski et al., 2010) and risk of readmission (Chopra, Wilkins, & Sambamoorthi, 2016) or even suggest lower readmission rates with a shorter length of stay (Kaboli et al., 2012). Thus, it is vital to determine the point of patient discharge that also considers the lowest risk of readmission. To reach this goal, the process of patient discharge and the involved stakeholders have to be known.

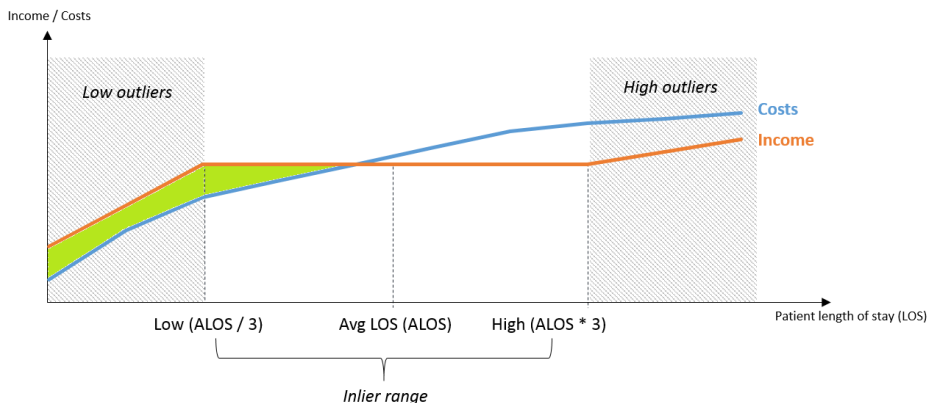


Figure 1: Correlation between patient length of stay and costs

The purpose of this study is to determine the decision makers and criteria that are relevant in the patient discharge process. For this purpose, focus group interviews are held in an Australian hospital group in Victoria. Based on the results of these interviews, propositions about the patient discharge decision and its implications are derived from the qualitative results. In a subsequent study, these results will be further developed into hypotheses and tested with episode data collected at the respective hospital group. This paper is structured as follows. The related work section briefly describes relevant stakeholders and decision criteria that have been previously identified for the patient discharge process. While a lot of studies suggest qualitative approaches to determine these criteria, we propose a mixed-methods approach to quantify the influences on patient length of stay and the patient discharge respectively. Section three afterwards describes our proposed method and the research design. Subsequently we present the results of the qualitative study and based on that, derive propositions on factors influencing patient length of stay. Finally, the limitations of this study as well as future research opportunities are discussed.

2 Related Work

The following section describes the results of our literature analysis concerning decision makers and decision criteria in the patient discharge process. The results form the basis for our qualitative analysis by supporting the selection of our focus group participants as well informing the development of our semi-structured interview guidelines.

2.1 Decision makers

While the final decision to discharge a patient resides with the primary physician, other groups have been shown to influence the time of discharge from the hospital. According to Armitage (1981), relatives play a vital part in the discharge negotiation, where both a shorter or a longer stay than necessary could be requested. Depending on their personal situation, their environment after discharge or their general well-being, a patient can also act as an influencer in the discharge decision. From the hospital personnel perspective, nurses tend to give suggestions and actively participate in the evaluation of a patient's well-being. As they are the closest caregiver to the patient in the hospital setting, they can sometimes better determine a patient's status and have a deeper understanding of a patient's personal situation than the treating physician (Hofmeyer & Clare, 2014). Finally, the treating physician, as well as other consulting doctors primarily, evaluate the clinical factors. They provide the final discharge decision with respect to the input of other stakeholders, clinical guidelines or other underlying conditions, such as ethical considerations (Chadwick & Russell, 1989).

2.2 Decision criteria

A literature review conducted by Harun et al. (2014) identified 17 studies analysing the patient discharge process to determine influencing factors in this context. They found several medical and non-medical influences on discharge decision making through either prospective or retrospective studies (cf. Figure 2). Literature shows, that mostly qualitative studies are conducted to identify impacts and behaviours of patient discharge. Thus, the results solely rely on subjective opinions of the interviewees.

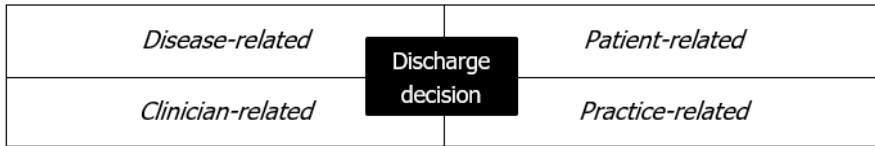


Figure 2: Influencing factors on discharge decision making (Harun et al., 2014)

The factors identified in these studies can be assigned into two major categories: Measurable and non-measurable factors (Table 1). While non-measurable items can only be gathered and interpreted through qualitative methods, measurable information can be collected and used to quantitatively test their impact on the patient discharge decision and their outcomes. This way, quantitative factors can be used for decision support to complement qualitative factors, such as ethics and intuition. The decision criteria as suggest in this study form the basis for our focus group interview guideline. We thereby especially focus on the measurable factors to initially derive proposition and testable hypotheses in a next step.

Table 1: Decision criteria for patient discharge

Influencing factors	Characteristics	
	<i>Measurable</i>	<i>Non-measurable</i>
<i>Disease-related</i>	<ul style="list-style-type: none"> - Diagnosis - Severity - Readmission risk 	
<i>Clinician-related</i>	<ul style="list-style-type: none"> - Clinician’s experience and expertise - Level of seniority 	<ul style="list-style-type: none"> - Intuition - Personality - Perceptions - Ethics and values
<i>Patient-related</i>	<ul style="list-style-type: none"> - Quality of life - Socioeconomic and functional status - Ability to self-manage - Insurance 	<ul style="list-style-type: none"> - Behaviour - Patient/Family preferences or expectations
<i>Practice-related</i>	<ul style="list-style-type: none"> - Practice patterns - Resource constraints - Policies and guidelines - Information availability 	<ul style="list-style-type: none"> - General practitioner or community care support

3 Method

This paper presents the first part of a mixed methods approach (Venkatesh, Brown, & Bala, 2013; Venkatesh, Brown, & Sullivan, 2016) following a qualitative study design. As such, mixed methods research “uses quantitative and qualitative research methods,

either concurrently (i.e., independent of each other) or sequentially (e.g., findings from one approach inform the other), to understand a phenomenon of interest” (Venkatesh et al., 2013). This study is conducted sequentially, i.e. the results of the qualitative study in this paper will be evaluated with a quantitative analysis afterward. The aim of this study is to derive propositions on the impacts and implications of time of patient discharge. Thus, in a first step, focus groups are conducted at an Australian hospital group to determine decision makers and criteria for patient discharge and the relevance of readmissions in this context. Figure 2 shows the proposed approach as well as the areas under study.

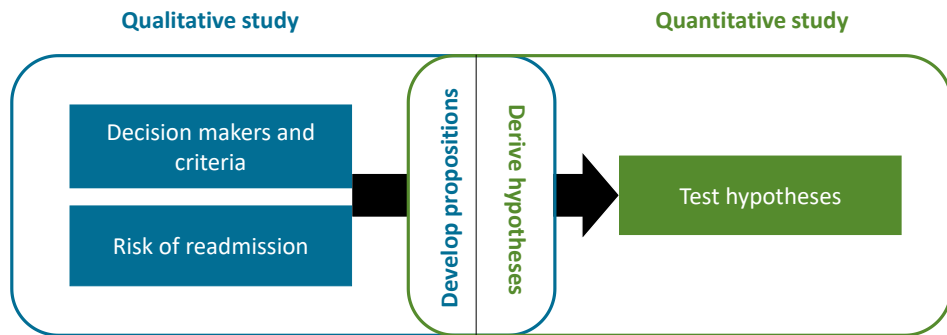


Figure 2: Mixed methods approach

Study population

We held three focus groups with 4 participants each, consisting of 7 men and 5 women, thus 12 participants in total. Each session was facilitated by a moderator and lasted about one to two hours. According to Krueger (2015), focus groups should follow five key criteria. First of all, small groups of people are assembled, usually ranging between five to eight people. However, so-called mini-focus groups with four to six people, are becoming increasingly popular as they provide a more comfortable environment for participants and allow every person to be able to participate. Furthermore, the select participants should possess certain common characteristics to be suitable for the topic under discussion. In our study, the homogenous environment of an Australian hospital group is selected as the main criterion in group member selection. The groups consisted of medical and non-medical personnel from various departments, such as the ICU, Research, Clinical Audits, Quality Management and the Emergency Department. The focus of these focus groups, on the one hand, was the determination of stakeholders and decision makers as well as their concerns and criteria for the time of patient discharge. On the other hand, we addressed the topic of the risk of readmission, and how readmissions are detected and handled in the hospital. Next, the goal of focus groups is to collect qualitative data to gain different insights and opinions across groups that can subsequently be compared and contrasted. Finally, this method utilizes a focused discussion „to get a range of opinions about a something like an issue, behaviour,

practice, policy, program or idea“ (Krueger & Casey, 2015). A semi-structured interview guideline was prepared and reviewed to ensure consistency throughout all focus groups, yet allow for some flexibility within the specified topics. For this purpose, focus group questions were developed by the research team according to three main areas:

- Decision makers and factors influencing the time of patient discharge
- Factors influencing the risk of readmissions
- Information availability

The aim of the focus groups was thereby to identify the issues, behaviours and needs for patient discharge with regards to the risk of readmission and the available information in that process.

4 Results

In the following section, we describe the results of our focus group interviews according to our three main areas. We identify decision makers and influencing factors on the patient discharge decision as well as the impact of the risk of readmission. To specify, we utilize the patient length of stay as the comparative indicator for the time of patient discharge.

4.1 Decision makers

The results of the focus group support the results from our literature analysis but give a deeper understanding of the discharge negotiation. Requests from family members and patients to stay longer are taken into consideration in accordance with medical necessity and availability of resources. “Family members or patients often push for a longer stay; [...] the requests are taken into consideration, but it requires a conversation about the medical necessity”, “Patients and family often ask to stay longer. Since it’s a private hospital that can sometimes be arranged, depending on the available beds.” According to one interviewee, this especially happens with readmission cases, stating that “if they’re nervous, especially if the patient already had multiple readmissions they want to be on the “safe side”. Similar to the results from literature, the focus groups agreed that usually “nurses make the suggestions for discharge, when they feel that the patient is well enough”, but that in the end “the consulting physician has the final say and makes the decision when the patient is discharged”. In case a patient stayed at multiple wards or “saw multiple doctors, they will make a decision together”. Depending on the ward a patient is treated at, there can be specific people in charge that lead the decision. In ICU, one interviewee stated that “the decision to discharge [...] is made by the intensive care specialist in conjunction with the treatment team, so the physician, surgeon, etc. The physician will determine if the patient has been stable for a certain time, if the blood tests are, if not normal, at least trending in the right direction.” In the special case of private hospitals as in the case under study, insurance can also play a role in the sense that “if the patient runs out of insurance, then the patient is transferred to a public hospital”.

4.2 Influencing factors on time of patient discharge

Within all groups, the type and severity of the diagnosis were concluded as the most prominent factor. One person stated that „The time of discharge depends on how what they come in with and how frail the patients are and why they needed the medical care in the first place”. Similar, others referred to this as “the complexity of admission” or proposed that the best time of patient discharge mainly “depends on what he/she comes in with”. Our first proposition that is derived from our interviews, therefore, suggests a significant difference within the durations of patient visits:

P1: There are significant differences in patient length of stay between different diagnoses.

Going further, not only the type of diagnosis but also the severity of the condition and frailty of the patient were mentioned as relevant factors. Therefore, we further propose to differentiate time of patient discharge and length of stay within diagnoses groups:

P2: There are significant differences in patient length of stay within diagnoses groups depending on the disease severity.

4.3 Influencing factors on risk of readmission

Next, our interviews show a varying perception of the benefits and threats of a later time of patient discharge. While some participants argued that a shorter length of stay is more beneficial for patients (“There are multiple risks of longer hospital stays: infection, blood clots, pressure sores, etc”; “It’s best, to get people out earlier, because an earlier discharge can improve the outcome”), some interviewees propose that they tend to keep critical patients for longer to make sure a patient is healthy enough to leave. One participant stated “The more critical a patient is, the longer the required “period of normality” before they are discharged.” Thus, the time of patient discharge shouldn’t be both too early or too late, leading to our following proposition:

P3: The length of stay has a significant impact on the risk of readmission.

Furthermore, the interviews show that this applies even more to certain patient groups, especially for chronic diseases. “Especially patients with chronic diseases are often “frequent flyers” in the hospital, for example, renal failure, Diabetes, Airways disease, Cardiac disease. [...] These patients make up 80% of medical activity and cost”. We, therefore, conclude the following propositions:

P4a: There are significant differences in risk of readmission between different diagnoses.

P4b: There are significant differences in risk of readmission between within diagnoses groups depending on the disease severity.

Figure 4 displays the theoretical model of the derived propositions, visualizing the relationships between diagnosis, disease severity, the length of stay and risk of readmission.

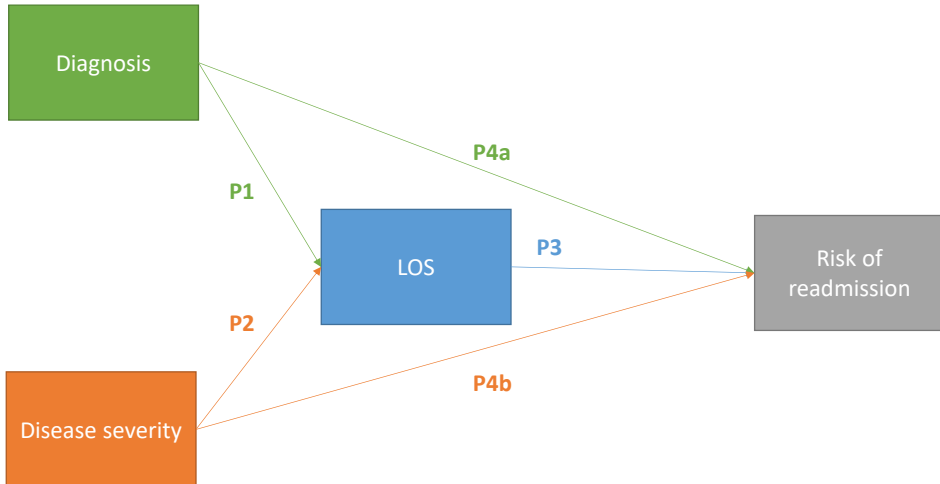


Figure 3: Theoretical model of influencing factors on length of stay and risk of readmission

4.4 Information availability

The third part of the focus group interviews focused on the type and amount of available data that is required in the discharge process. In general, one interviewee stated the discharge decision requires input about “the objective, medical factors as well as subjective factors”, i.e. intangible information that cannot be measured. These subjective factors are usually determined by the physiologist.

The availability of information can also negatively impact the length of stay i.e. lead to a delayed time of patient discharge. “[...] Having the data available sooner or digitally may or may not improve the decision of patient discharge, but It could improve the efficiency of discharge because a delayed discharge is bad for the patient and the hospitals.” A delayed discharge can increase the risk of hospital infections and can result in penalties for the hospital if the length of stay is continuously too long across multiple episodes.

Besides increasing efficiency through digitized data, the advances of more complex data analysis and visualization were discussed within one of the focus groups. “It wouldn’t be enough to digitize the information, but to combine the information and use more complex information to show doctors more sophisticated overviews of risk etc.” In that sense,

individual data points might not be critical, but in combination, they might show relevant information to the clinician. As one physician stated: “The complexity [of data] outpaces the availability [of clinicians] to digest the information”. Within this discussion, the application of Business Analytics or Machine Learning methods was proposed as helpful to counteract this complexity. An intuitive visualization is thereby key to filter out the relevant information. “It’s important to quantify and visualize the results from such analyses, e.g. % likelihood of deterioration”. Especially information concerning the potential risk is not yet assessed in detail, even though unnecessary readmissions could be avoided with this knowledge. “The information of risk assessment of a patient is collected, but not really used. If that information was visualized properly (e.g. a different light for a high-risk patient in ED), that would be very helpful.”

This information could be both helpful for treatment of individual patients as well as on a more organizational level. For this purpose, aggregated data for each DRG group or specialty could be displayed to improve hospital coordination and management. On an individual level, the risk for each patient could support clinicians to determine the best time of patient discharge.

5 Discussion

In this study, we identify decision makers and influencing factors in the patient discharge process and for risk of readmission and shortly discuss the potential of data analytics and visualization in the healthcare context. As the first part of a mixed method study, we develop semi-structured focus groups interviews that are carried out at a not-for-profit tertiary Australian hospital group. The results of the interviews show similar findings as our initial literature review considering decision makers and criteria in patient discharge, but give a deeper understanding of the discharge negotiation.

The analysis of these focus groups results in five propositions on the influencing factors on length of stay and risk of readmission in private hospitals. Our aim is to further develop these propositions into a testable model and derive hypotheses on the relationships between these influencing factors. For this purpose, we will collect data on patient episodes at the case hospital to further specify our proposed theoretical framework in a follow-up study. By following a mixed methods approach, the qualitative results of the focus group interviews can be further supported by quantitative evidence and therefore strengthen our initial results. Thus, the identified stakeholders involved in the patient discharge decision can be supported during this process by utilizing data-driven insights to find the optimal time of patient discharge. The results of the focus groups also show a high interest and applicability of data analytics in the healthcare context to enable faster and more evidence-based decision making.

This study aims at providing a deeper understanding into the patient discharge process and gives suggestions on how the use of data analytics could support this process in the future. From a research perspective, the quantification of influencing factors on patient

length of stay adds to the current understanding of criteria in patient discharge from qualitative studies. Based on these initial results, future studies could use the identified features to address issues related to patient discharge such as the detection of patients at high risk of readmission. This, in turn, could help practitioners to make more evidence-based decisions in the patient discharge process.

The results of this study have to be considered under certain limitations. First, the participants of the focus group were selected from a single hospital group. To provide generalizable results, further studies have to be conducted at different sites. Second, the propositions developed in this paper are not yet quantitatively evaluated and are based on the authors' interpretation of the qualitative results. This restriction will be approached in a follow-up study using patient episode data at the hospital under study.

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Analysing Digital Transformation among Hungarian Organizations

PÉTER FEHÉR, ZOLTÁN SZABÓ & KRISZTIÁN VARGA

Abstract This paper presents the findings of a research on Digital Transformation, performed among the Hungarian companies in the first half of 2016. Investigated organisations consider digital business transformation as a key issue. Many factors influence Digital Transformation readiness: risk-tolerance, development of IT skills, and conscious management of innovations ideas. Adequately aligned IT strategy can be also a catalyst of digital strategies.

Keywords: • Digital transformation • Innovation sources • Digital strategy
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1 Introduction

In the new era of technology-enabled competition, many organizations have to deal with disrupting technologies, emerging new competitors, challenging IT-based innovative models. In many industries, digital transformation is a key enabler of future success or survival, by better connecting digitally with consumers, partners, by improving internal efficiency through improved process, by facilitating deeper insight and business intelligence, and by providing enhanced products and services (Capgemini, 2011).

The increasing use of integrating digital technologies (social media, mobile applications, business analytics and cloud based services) has a transforming impact on companies and on how their businesses work. The depth of changes is dependent on digital maturity. Digitally less-matured businesses have limited opportunities by concentrating on solving discrete business problems, using individual digital technologies. Digitally most matured organizations develop digital strategy based complex innovations to transform the business (Kane, et.al. 2015).

Digital business is a complex approach influencing all aspect of operations, provides several benefits, like improved transparency and control of operations, extension of IT based systems, data collection and analysis, increased integration of business applications, transforms analogue process to streamlined and efficient digital ones. Typical organizations have internal efficiency and operational focus, while the digitally matured organizations the priorities are: automation of processes, distant control and execution of procedures and automation of human activities.

Pressures for digital transformation are also present in Hungary. This paper presents the findings of a research on Digital Transformation, as a new and special part of our yearly IT management survey of Hungarian organizations. Research data were collected through anonymous questionnaires, and complemented with case study findings. The questionnaires were filled voluntarily, mostly by top and mid-level executives. Our survey panel consists of over 100 Hungarian organizations, that have critical IT infrastructure, they are valid representatives of conscious Hungarian information management practitioners. Most of the respondents were invited through the Hungarian professional communities (CIO Association, itSMF Hungarian Chapter). Almost 19% of the organisations are micro or small enterprise, 27% are medium-sized enterprise, and 54% of them are large-sized enterprises. Organisations both represent the public sector (22%) and the private sector (78%).

Our goal was to explore the attitude of Hungarian companies towards the concept of digital transformation, to identify patterns in the implementation or plans, and to provide a deeper understanding of the problems and impediments of digital transformation oriented initiatives.

Based on the survey our intention with this article is to investigate the following issues:

- Strategic perspective: How do companies integrate digital transformation concepts to their strategic planning, especially to IT related strategic thinking?
- Innovation perspective: What are the origins of innovative ideas in organizations, how do they explore new opportunities?
- Implementation perspective: Are the Hungarian organizations prepared for digital transformation? Have they the necessary competencies and resources? What are the major enabling/inhibiting factors?
- Technology perspective: What are the relevant IT initiatives, innovative technologies that are frequently used in Hungarian companies?
- IT organizational perspective: What is the role of IT units in digital transformation?

2 Survey Results: Digital Transformation in Hungary

Research results confirmed that the investigated organisations consider digital business transformation as a key issue. The research also points out that there are many uncertainties on the way towards digitization: organizations cannot foresee the challenges and opportunities, and only some of them marked out clearly their digital business strategy, or even just a few implemented digital transformation projects. Most of the companies are not so enthusiastic about the risk related to the introduction of innovative digital solutions.

2.1 Digital Strategy

Bharadwaj et al (2013) states, that a digital strategy should be different of traditional IT strategy. An organization's IT Strategy should focus on business needs, the ability of IT to meet those needs, how to close any gaps, how decisions will be made and how to measure progress (CIO Magazine, 2008). Dave Aron (2013) from Gartner stated, that IT Strategy is a technical answer to a business question, while Digital Strategy is a business answer to a digital question.

So, digital strategy in a cross-functional strategy, that address all functions and processes of an organization. The role of IT strategy is to fulfil the requirements of the digital strategy, that is interpreted as a business strategy.

Our research showed, that almost half of the surveyed organizations include digital transformation issues into their organizational strategy, while a little more than a quarter of the organizations include digital transformation questions into their IT strategy. Moreover 10% of the organizational have an independent digital transformation strategy, and 15% of the organizations have no digital strategy at all.

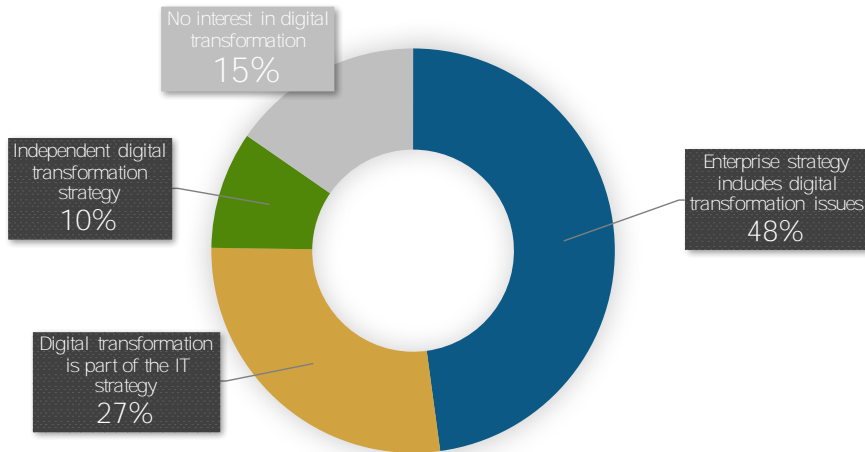


Figure 1: Digital transformation is not part of IT strategy

The results partly follow the insights of Bharadwaj et al (2013), as most organizations integrate digital questions into their strategy, but there is still a huge number of organisations which still believe the role of IT in these questions.

Moreover, if we analyse how the business and IT strategy is related to each other, we can realise, where strategic alignment of business and IT could be accomplished, higher share of business integrated digital transformation is present (65% vs. 50%), and there is no independent digital transformation strategy at all. Companies developing IT strategy as a derivative of the business strategy are less interested in digital transformation, some of them have an independent digital strategy, and the IT unit's influence on digital strategies is weaker. Companies having integrated business and IT strategic planning are more active in digital transformation, and they tend to involve digital innovation to their existing planning activities. Based on these results, an adequately aligned IT strategy can be a catalyst of digital strategies.

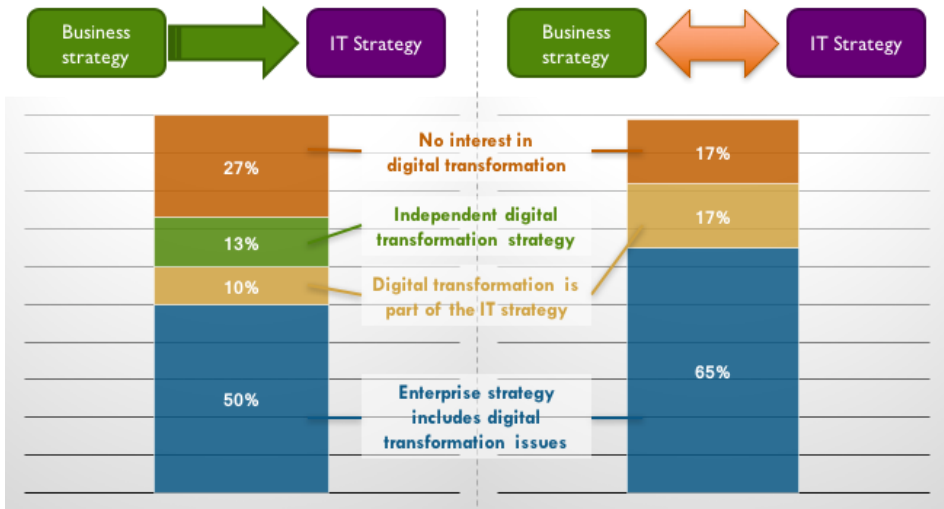


Figure 2: Level of strategic alignment influences the attitude towards digital strategy

2.2 Innovation Process - The Origin of New Ideas

Even though there is the willingness and implementation capacity, solutions are needed that meet external (customer) and internal (staff) requirements. Therefore methods and approaches of idea-generation and collection in companies are key issues.

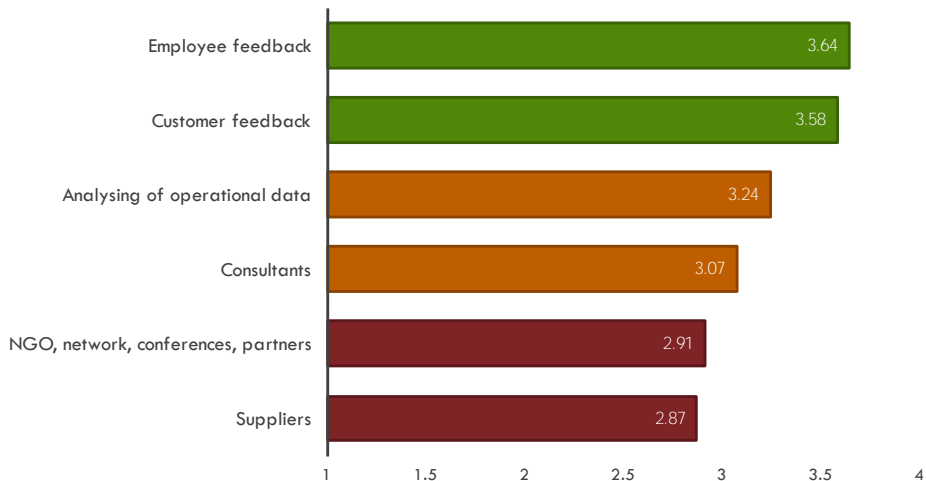


Figure 3: Both external and internal sources support digital transformation (1-5 scale)

Based on the survey results idea-collecting activities of companies are somewhat stronger than the medium in average, but there are various levels of emphases on the different sources of innovative ideas. The two most important area mentioned are the external (customer) and internal (employees) related ideas, there is no significant difference between the importance of these sources. Companies put much less emphases on systematic exploration of the operations, collection and evaluation of data related to operations.

In addition to these feedback sources the statistically analysed data and focused customer and employee data collection, process monitoring, problem detection may be the best basis for organizations to identify the improvement opportunities of activities, processes customer experience.

Although placed backward in the survey, outside opinions (analysts', consultants', supply chain representatives', or partners' and competitors' experiences and ideas) can be also a valuable source of innovation.

3 Planning and Implementation

Recently many CEOs generally understand the strategic opportunities and threats of digital transformation, and developed a vision or even a strategy for their companies to initiate changes. On the other hand, most organizations have only insufficient skills and knowledge in digital business, which can be a major impediment of executing the digital strategy (HBR 2015).

Digital transformation has become the major facilitator of business success, it provides new approaches to optimise processes, improve data analysis and extend customer relationships. Although technology can be mentioned as a key enabler of recent business innovations, it is generally accepted that strategy is the key driver in the digital arena (Kane, et.al. 2015).

The digital business transformation can bring significant changes in the life of organizations, but it means also significant risks. This dichotomy can be observed in most of the companies: despite the importance of digital transformation for many organizations, organizational readiness is a key factor in the assessment of risks. While the domestic entities reported the strategic importance of the issue (on a scale of 1-5, 4.15), they evaluated their own preparedness to a much lower level. Organizations estimated their technological knowledge and skills necessary for digital transformation just slightly higher than the medium level.

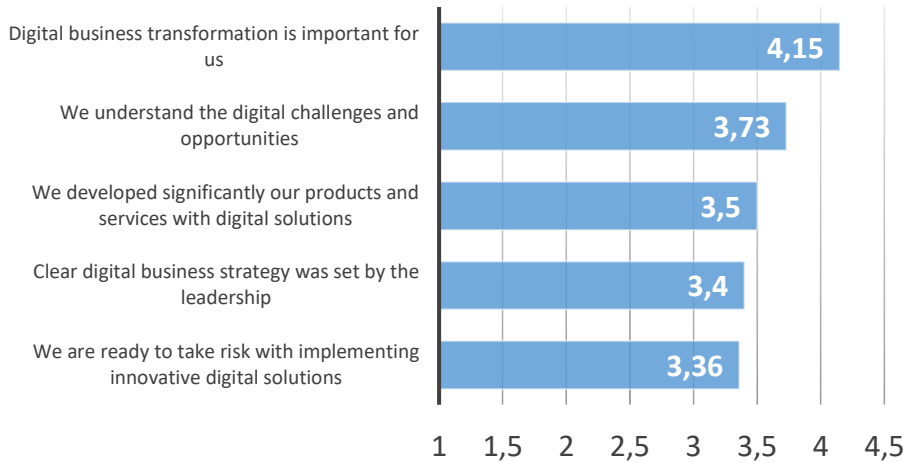


Figure 4: Despite importance making it happen is not trivial

Lack of clear vision and mission is a top barrier mentioned in international research (Rich, 2017), just as cultural and organizational issues. From this perspective, the situation is promising (the importance of the digital transformation is generally accepted), but the key aspects of the implementation capabilities are just slightly better than medium. Culture of innovation is not the strongest feature of many organizations (Capgemini, 2011), so the Hungarian results are also not surprising.

In this sense, we can understand the risk-avoidant behaviour of the organizations, since taking a risky step requires preparation and knowledge:

- Employees should have IT knowledge and digital skills (and it is not just the privilege of the IT staff), and organizations should consequently develop these skills
- The organizations should consciously monitor and evaluate technology trends, innovative solutions should be piloted
- companies should set up a group with well-defined goals, roles and responsibilities to implement digital transformation.

According to the results of Weill and Aral (2006) high IT savviness is originated from five characteristics of successful organizations, amongst them companywide IT skills and management involvement. Our results showed that companies recognized the strategic importance of the digital transformation, but the implementation related competencies should be developed further. Analysed companies evaluated their ability to give quick response to the fast environmental changes at lower than medium level, so the implementation capability should be significantly improved.

Most of the leading service providers reported in a survey (Rich, 2017), that they are still in the early stages of their transformation program. The overall observation of our survey was somehow similar, but in Hungary many companies are just in an experimental phase, complaining about many issues – lack of experiences, lack of skills, etc.

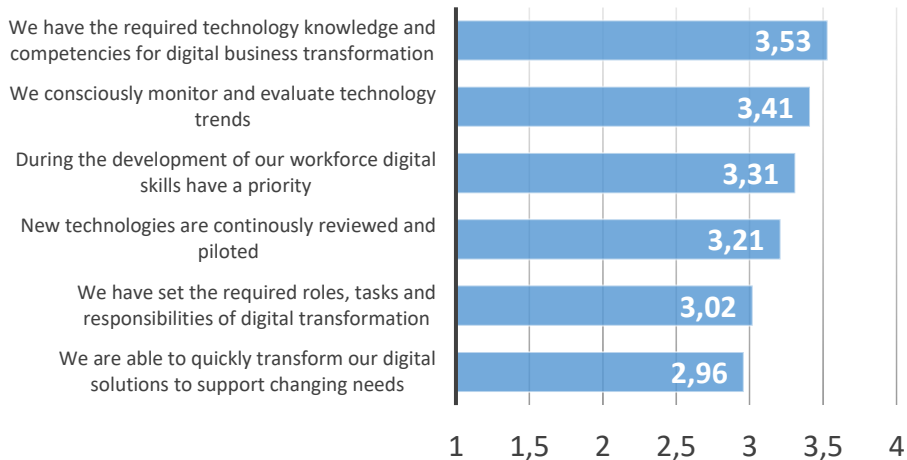


Figure 5: There is the will for digital transformation (1-5 scale)

4 The Role of IT in Digital Initiatives

In 2016 digital transformation primarily occurred in cloud and mobile platforms, but companies improved their communication technologies and great attention was paid to the integration of social media solutions. The transformation does not only mean the introduction of IT solutions, but also requires the change of organizational operations or the transformation of processes, even with the introduction of radical, new solutions. Our results are similar to other surveys (e.g. BT (2016), where the most widespread disruptive technologies are the cloud (58%), mobility and collaboration (54%); while the popularity of data (BI, big data) related initiatives were much less frequently mentioned in Hungary (19%) than on international level (52%).

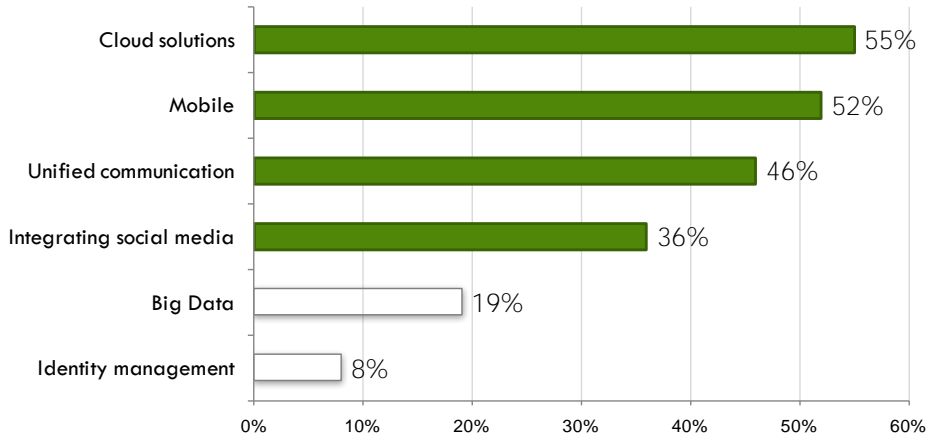


Figure 6: The most important technologies drive digital transformation (project started in 2016 by the organization)

The organizations in our research think, that IT knowledge is necessary to the digital business transformation in all areas – the difference may be in the extent. Not surprisingly, the leader of the list is the IT area, but more importantly, the responders evaluated the existence of digital knowledge in most areas higher, than 'medium'. What's more, the business respondents evaluated digital knowledge in marketing, finance, accounting and logistics more important compared to respondents from IT.

While IT knowledge necessary for the business transformation is required from IT professionals by organizations, the role of IT seems to be more supporting: to address security issues, the implementation capacity (supplier management, development, project management), architecture design. Interestingly, participation in innovative projects (initiation or execution) pushed to the end of the list – but it is worth noting that even this category is stronger than 'medium' (1-5 scale: 3.84 and 3.77).

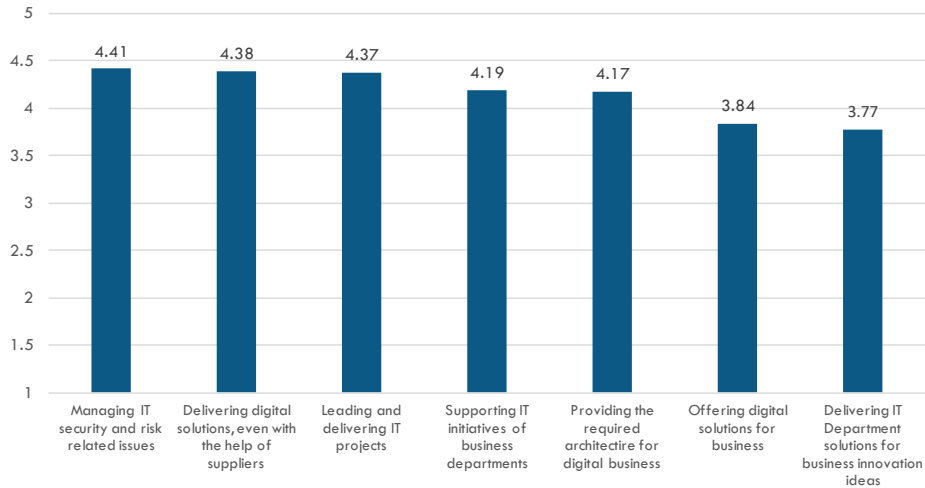


Figure 7: Role of IT departments in digital transformation (1-5 scale)

It seems that IT, and IT leaders have to manage an interesting situation: their knowledge is essential to the successful implementation of digital business transformation, but our research showed that in the making of ideas or innovation business areas do not rely on them. Business areas often go their own way, and involve IT areas later – sometimes too late. As evidence, we have seen that most organizations consider the digital transformation strategy distinct from IT strategy, and they put the emphasis on business issues such as how will my business processes change, what can be used from an existing digital toolbox.

Since the use of cloud services is increasingly widespread in Hungary, it can happen easily that business areas decide to use IT services without involving the IT - then of course they need integration, standardization, and raise security issues. This leads IT to lose control and the opportunity of proactiveness.

5 Conclusion

Our research results showed that the Hungarian companies have a positive attitude towards the digital transformation concept, the general level of awareness is high. Among the analysed topics we discovered some general patterns:

- Maturity in Strategic alignment has a positive effect on digital transformation planning and initiatives.
- Companies combine external (customer) and internal (staff) innovation ideas, and less active in other potential sources of digital transformation initiatives.
- technology is a key enabler of digital transformation, cloud based application and mobile initiatives are still very popular.

There are also many problems related to the concept:

- The implementation capability should be significantly improved.
- IT knowledge and skills are important not just for the actual development, but for the awareness rising and idea generation.

The current question that IT managers face nowadays: what will be their role in digital business transformation, and what extent can they remain part of the whole process? While the IT area is best suited to identify and test new technologies, it will have to evolve in order to comply with users', customers' needs, and offer services in business language. Another important area to be developed is speed: if IT is not capable of quick changes or supply fast solutions, business areas can take over control.

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Using Design Thinking to Identify Banking Digitization Opportunities – Snapshot of the Hungarian Banking System

PÉTER FEHÉR & KRISZTIÁN VARGA

Abstract In our research, we used Design Thinking and our "One Week Sprint" methodology to identify digital transformation opportunities for the Hungarian banking sector. Our main findings can be grouped to three main areas: (1) the changing role of branches (2) online, mobile and phone-based services and (3) products and services. The compound of customers is quite heterogeneous in age, education or income status for all banks in our research, therefore, the possibility of generalization of problems and possible solutions is limited. A major challenge for banks is that they need to think up to 20-30 customer segments, and offer services with which can serve the needs of other segments – so generic enough to meet more segments' needs. Of course, the strategies of banks may differ in the targeted segments; however, banks with general strategy can be dominated by competitors concentrating on a niche strategy, or a FinTech, for example, with the widespread application of digital solutions.

Keywords: • Digital Transformation • Design Thinking • One Week Sprint
• Banking •

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1 Introduction

Although the banking industry is a traditional and conservative industry, it has to follow the required changes of digital transformation. Although the banking industry is heavily dependent on technological solutions, this change is not encoded in the genes of the banks. Moreover, identifying possible digital developments is harder, than the banks think.

The goal of our research was to analyse to identify customer challenges of Hungarian retail banks, to develop and to test digital ideas to address these challenges. For this research, we were collaborating with seven Hungarian banks, and analysed both online and offline customer challenges. The goal of this paper is to overview the related concept in the literature, and present the results of this research.

2 Related concepts

The goal of this chapter is to analyse the current challenges of digital transformation, presenting the challenges of the banking industry, and analysing how customer centric digital innovations can be delivered.

2.1 The challenge of Digital Transformation

Digital developments were traditionally dedicated to the responsibility of IT Departments. Although the alignment between business and IT goals was a never-ending discussion of both practitioners and researchers (Henderson and Venkatraman, 1993; Renaud et al (2016); Kahre et al, 2017), the leading role of organizational IT was not really questioned, and outsourcing of IT services usually arose mostly in operational issues.

By now, the exclusivity of developing new IT services, and delivering digital innovations has loosened, mainly because of the following reasons:

- As digitization reached business departments, the requirement of IT knowledge, and IT savvy employees became vital of organizational success (Weill and Aral, 2006). Therefore business leaders and employees had to acquire digital skills, so IT departments' knowledge monopoly is under demystification.
- As Software-as-a-Service (SaaS) solutions, especially cloud-based solutions became more and more accepted, business units have the opportunity access IT services without involving their IT departments (Katzan, 2009; Foster, 2011; Sultan, 2013). Moreover, introducing a new IT service into business operations via the SaaS model takes less time than the traditional implementation projects (Waters, 2005; Gerhardter and Ortner, 2013).
- Not only the speed of implementing new services is an issue, but also the quality of new services. As IT solutions, like infrastructure, or access to internet became

a commodity for most organizations (Carr, 2003), the transaction cost of choosing or changing SaaS services decreased, therefore organizations can select innovative SaaS solutions with lower costs and lower risks. As Carr (2003) urged, “it’s time to rethink IT management”.

Therefore, Bharadwaj et al (2013) claim that business units lead the way of digitization, and digital business strategies are separated from traditional IT strategies, as digital strategies address cross-functional business objectives, and changing business processes by utilizing IT resources. Digital strategy is treated as business strategy itself.

2.2 Digitization challenges of the banking sector

Digital technologies have been entering the banking industry for years, and the banking industry and banking operations and highly dependent on the IT services (Fung, 2008).

Shaikh and Karjaluoto (2016) originates automated retail banking services into the mid-1960s, because of the requirement of processing the huge number of credit-card related electronic transactions. Since then, digital solutions are not uncommon in the financial sector: ATMs in the late 1960s and 1970s, telephone banking and POS solutions since 1980s, online banking and even mobile banking since late 1990s.

Motivations of digitization was faster and cheaper customer service. Despite of these efforts and digital achievements, banking services still seem to be lagged behind general digital technology trends, and behind the digitization of other sectors, especially commerce (Harvey, 2016).

The situation is more challenging for the banks, as their customers take their financial services from different service providers (e.g. account, mortgage, commercial credit, credit card, etc.). Easy to access internet-based services make this situation even worse: using SaaS services on the internet provides low transaction costs for trialling, selecting or changing alternate service providers. Moreover, Y-Generation and technology-savvy customers demand and appreciate digital services, and these segments are ready to change for a better digital customer experience (Lipton et al, 2016).

Beside the changing customer behaviour, banks have to face new challenges (Harvey, 2016):

- As new entrants, FinTech companies offer digital financial services in several niches. FinTech companies act as startups, frame a very specific customer challenge, and offer very specific solutions (e.g. money transfer, microloan, crowdfunding, payment, etc.). One FinTech service probably will not endanger banks, or the banking sector, but together they target small but very profitable slices of the banks' value chains. Surprisingly banks didn't start to address this challenge, yet (Bunea et al, 2016), although this hybrid financial model seems

to stick in the market, and questions the role of banks in the following years (Akkizidis and Stagars, 2016).

- Technology companies also enter to the market of financial services, as financial services became an integrated segment of their value offerings: Alibaba, Google, Apple, Samsung, etc. provide more and more financial services, which are technologically advanced, and moreover, they can target their existing user base.
- Since the financial crisis started in 2008, government and industrial regulations became stricter, and require banks to apply and report these requirements (Goodhart, 2008). These compliance issues require additional investments in technological solutions (reporting, data analysis, fraud protection, anti-terrorism analysis), and makes their service offerings less flexible, and sometimes less user friendly.

2.3 Customer centric digital innovations

As customer behaviour is changing, it is not enough simply to offer new digital services, or just to copy the existing services of the competition. Even before the age of digitization, customer experience questions were highly important, and loyalty of banking customers was related to perceived value, service quality, service attributes, satisfaction, image and trust (Beerli, 2004; Lewis and Soureli, 2006). Digital services are expected easy to use, comfortable, natural, but moreover, the solutions should service the need of the customers.

FinTech companies, and digital innovators not simply digitalize or automate existing processes, but adequately understand customer challenges or new requirements, in which customer experience has a vital role (Harvey, 2016; Kenesei and Sepródi, 2017).

The need of a better-grounded design of products and services started by Herbert Simon (1969, 1996), as defining the role of design as “the transformation of existing conditions into preferred ones” (Simon, 1996:4). Further researches added additional layers to the discourse, applying different epistemology and core concepts (Johansson-Sköldberg et al, 2013):

- Rationalism: The science of artificial
- Pragmatism: Reflection in action
- Postmodernism: Wicked problems
- Practice perspective: Designerly ways of knowing
- Hermeneutics: Creating meaning

Nonetheless of the evolvement of the design process, further thinking still refers back to Simon’s framework and practical approaches try to integrate all discussed concepts (Huppertz, 2015). The art of design, the systematic way of designing products and serviced

is labelled as “Design Thinking” (West and Di Nardo, 2016), and applies the following characteristics:

- Targets solving non-structured problems
- Applies a customer centric approach, analysing customer challenges through observation
- Emphasizes the importance of customer value creation and customer experience
- Emphasizes the importance of collecting and processing information from various sources
- Enhances creativity of participants
- Helps to bring together various actors: users, designers, developers, etc.

Because of the nature of a general design thinking approach, it is able to be a basis of digital innovations (Izukura et al, 2015; Hosono et al, 2016).

Inspired by the overview of different design thinking approaches by Gioia (2011:39) and based on the collection of Dam and Siang (2017) of the Interaction Design Foundation, and processing additional widespread models, a general design thinking process includes the following steps (Figure 1):

- Define: defining the scope, problem and challenges, understanding constraints
- Explore: explore the target area, context and stakeholders
- Interpret: process the explored insights and define the problem to be solved
- Ideate: collect, then evaluate multiple solutions
- Prototype: develop initial prototypes to illustrate the solution
- Iterate: test the prototypes, even in multiple cycles to enhance the idea and to select the most suitable solution
- Implement: develop the product or service
- Enhance: keep up with the product, provide support, analyse data and plan further developments (restart the cycle)

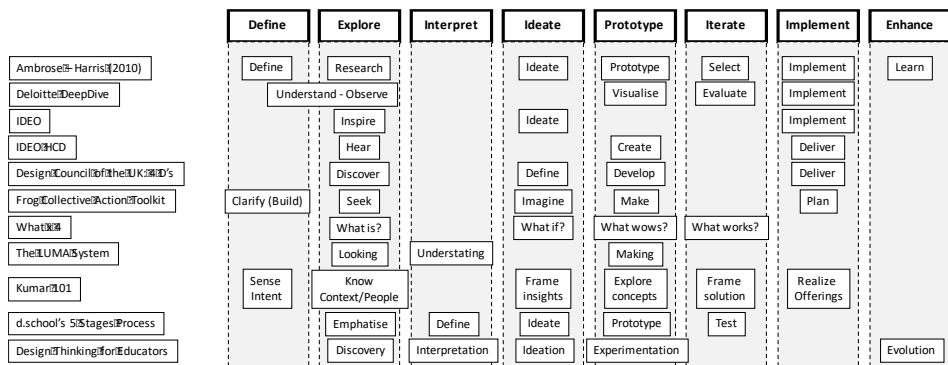


Figure 1: Different models to do design thinking

3 Methodology: "One Week Sprint"

The goal of our research was to explore and identify customer challenges in retail banking. To achieve this goal, 7 Hungarian banks joined to the project, of which total balance sheet altogether represents 68% of the Hungarian banking industry.

Nature of the research, exploring digital banking possibilities, the research was considered explorative. We wanted deeper insight than the traditional surveys and case studies, therefore we decided to select design thinking approach among the qualitative research methods. The Design Thinking approach can provide a deeper understanding of customer-centric challenges than traditional surveys or case studies through deeper involvement of observation. The Design Thinking approach also help to identify and evaluate as many challenges, as possible, and ideate as many solutions, as possible.

For the basis of the applied methodology the 5 steps approach of IDEO and Riverdale was selected (Design Thinking for Educators, 2012). Because we have limited time (5 working days) and limited resources (7 project teams, one for each participating bank, 34 project members and 2 coaches) we had to adapt the methodology to fit into these frames.

To achieve our goal, we used the following additional sources to construct our research methodology:

- The book of Knapp et al (2016) presents the methodology that Google uses for rapid prototyping of their ideas. Although we applied different phases and steps, this book helped a lot how to organize the week. This approach, the agile project blocks also inspired the name of our methodology.
- Although we heavily relied on the “Design Thinking for Educators” methodology, we used parts of additional design thinking approaches: Brown (2009); Ambrose and Harris (2010); Stickdorn (2012) Mootee (2013); Kumar (2013); Cosovan and Horváth (2016).
- To enhance creativity, we used additional creative techniques during workshops, based on the works of Sibbet (2010); Gray et al (2010); Michalko (2010 and 2011); Zichermann and Cunningham (2012) and Vogel (2014).

Based on these resources, we created the “One Week Sprint” format that consists of the following steps and content (Table 1).

Table 1: The “One Week Sprint” methodology

Number	Phase	Purpose	Description and guides
0	Preparation	Get an overview and common understanding of the general challenges of the banking industry	Collecting good and bad practices from a general banking industry, sharing personal stories. Summarise results and creating an initial problem map. Set the goal of the week
1	Discovery	Discovery builds a solid foundation for your ideas	Prepare for fieldwork: Build a question guide Fieldwork: Learn from experts / users, identify extreme users
2	Interpretation	Interpretation transforms your experiences / stories into meaningful insights.	Document experiences: share stories, document problems on post-it notes Structure problems, find headlines, turn headlines into statements Don't jump to conclusion, yet: explore all the problems first, before you go further! Get input from the outside: Explain the themes to someone who is not part of your team Make Insights Actionable! – How might we... Define the needs, through the eyes of the customer/user Add visual reminders (Process charts, Diagrams, Matrixes, Relationship maps) Select the need/problem you want to solve!
3	Ideation	Ideation means generating lots of ideas.	Brainstorm ideas Analyze ideas (Prioritization Grid, Selection criteria) Evolve your promising ideas Consider even radical ideas, look for the WOW factor! Select a solution to work with
4	Experimentation	Experimentation brings your ideas to life	Present your idea visually (paper/ppt prototype, storyboard,

Number	Phase	Purpose	Description and guides
			diagram, sample process, “create-an-ad”) Present your business model (one-page business canvas for products) Get feedback, test as much as possible, capture feedback learnings Iterate your prototype, create a new prototypes, repeat several times
5	Evolution	Evolution is the development of your concept over time	What will be your MVP? Track learnings & document progress Plan Next Steps: how will you develop your idea/product further? Create a timeline! Pitch Your Concept! Include risks, costs, benefits, value, etc.

During the research, each team was dedicated to a selected bank. Coordination of the teams and methodological assistance were provided by two leading researchers, in the role of design thinking coaches. The research team invested more the 1000 working hours during the 5 days to explore and analyse customer challenges, and provide viable ideas for the banks. In the discovery phase the main goal was to identify as many challenges as possible, while in the interpretation phase the teams prioritised these challenged and reduced them into a few for further work. In the ideation phase the teams brainstormed a huge number of ideas, but during experimentation only a few viable were selected and tested, and the successfully tested and iterated ideas got only the final phase. In the last phase the surviving few ideas were developed further: costs, benefits, risks were analysed, and a project timeline was added (Figure 2).

Following this methodology Project teams delivered their research findings at the end of the 5th day, concentrating on the main problems and main solutions. After the One Week Sprint, all the identified challenges, and possible solutions were collected and analysed further by the coaches. This paper presents these aggregated results.

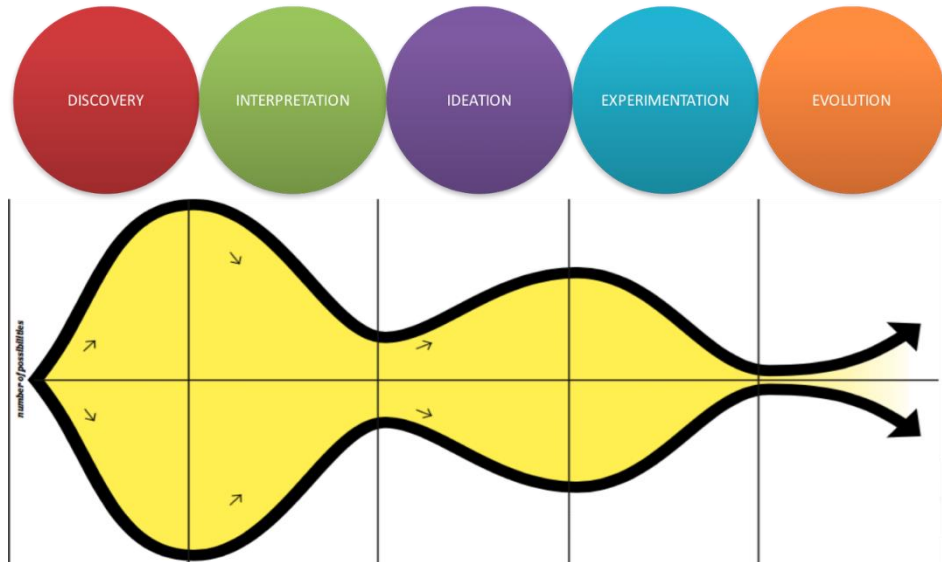


Figure 2: Overview of the “One Week Sprint”

4 Research findings

Our main findings can be grouped to three main areas:

- The changing role of branches
- Online, mobile and phone-based services
- Products and services

In each problem area, we present the identified customer challenges, based on our observation, then we present the possible solutions identified by the project teams. Although each project team was dedicated to a specific bank, customer challenges and problems overlapped of the different banks.

4.1 The changing role of branches

Customers articulated their most problems related to branches in Discovery phase (Figure 3.). As we investigated the area of branches in Interpretation phase, it appeared that no one loves to go to bank branches, especially not the younger generation. The access of a branch may be a challenge, since it may be too far, or the opening hours may not fit the customer needs; since they typically are open during working hours - when customers are working too. But once a customer reaches the bank branch, there is typically long waiting and administration time, and in the one hand customers do not always get what they wanted (clerks' quality); in the other hand they are confronted with pushed offers of new

products, services clerks try to sell them, which also increases the waiting and administration time.

The traditional functionality of bank branches was to serve as the central point of customer relations. However, for customers visiting the branch may be "only" a drag, or worse, it can mean frustration for them. From the banks side, the reducing number of customer visits should motivate branches to take advantage of these rare opportunities, improve customer relationships and trying to sell new products and services using their personal presence.

From the customers' side, the branch visits are considered as a task with no significant added value, so they would like to do it as fast as possible. And they consider all the things that prevent this (waiting, administration time, listening to offers) as annoyance.



Figure 3: Challenges related to branches

To manage these problems, nowadays it is considered natural to direct all possible administrative tasks to appropriate online channels (phone, mobile, web). The question remains: what to do with the bank branch where customers do not want to appear in person; and how to convince customers to choose the closest relationship: personal appearance?

The question is complicated because of the heterogeneous composition of the banks' customers, and there is no solution that would be appropriate for everyone. There are customers, who prefers personal presence in their sensitive banking affairs - and the customer experience should be ensured for them as well.

Suggestions made up during Ideation phase and tested in Experimentation phase:

- **Enrich waiting time:** Waiting is typically a lost time, both for customers and for banks. It is worth to make this time more meaningful, and provide an opportunity for interaction with the bank through personal assistants or electronic solutions.
- **Know the customers' intentions in advance:** It can speed up administration if customers can arrive to scheduled time, if they can indicate what do they want

to achieve, or what challenges await assistance from the bank in their actual phase of life.

- Speed up administration with online started processes: Although not all cases can be fully solved online, it can reduce administrative time in branches if processes can be initialized online, checked in the background; this way only the identification and signings have to be done in the branches.
- Change, or extend the function of branches: as the traditionally non-financial service providers enter the market of banking services, so should not the banks be afraid to build up a new kind of profile towards managing relationships with customers. Is not that a more direct connection if the branch is more like a café, where the clerks sit next to the customers with a tablet? Or, if the branch will become a - increasingly fashionable - community office at the same time? Or inverted: what is required for an agent to visit community offices, appearing elsewhere day-by-day as a mobile branch clerk to arrange matters? After all, the branch is not necessarily the physical space, but the place where the issues can be arranged.

One full project proposal from the Evolution phase was dealing with how to reduce waiting time and to understand the intentions of customers. If the waiting time may be longer than a few minutes, the customers should not draw a line number, instead, a tablet serves as a personalized caller. Through this device, the authentication of the customer and identification of the customer's preferences can be easily done. The customer can get familiar with the bank offers, and even express their interest in banking products. The customer needs can be assessed in the form of tablet games. It is important, that in these cases the bank can identify the real customer needs and offer those products only, that meet the real needs - even in a personal administration - rather than products typically offered to all customers. If the customer needs can be identified in advance, or detect lack of interest, the personal administration will be targeted, so it can be faster.

4.2 Online, mobile and phone-based services

Empowering customers to manage their issues in an online channel seems to be an obvious solution to most of the problems outlined in the previous section. Arranging issues online reduces the need of personal contact, which may ease the customers' life and lower operating costs for the banks themselves.

At the same time, managing issues outside the branch (via telephone, mobile, online) leads to challenges (Figure 4), that would have been easy to handle in the branch itself, such as inadequate supply of information, lack of consultation and the functional limitations of the different platforms.

Regarding the non-branch channels, the most frequently expressed counter-argument is the issue of security: whether the data of the customer will be stolen, what can ensure the customer that they are communicating with the bank itself, what can guarantee the

customers that their order will be really executed. These are the challenges we've found in Discovery phase with some of the possible reasons from Interpretation phase.

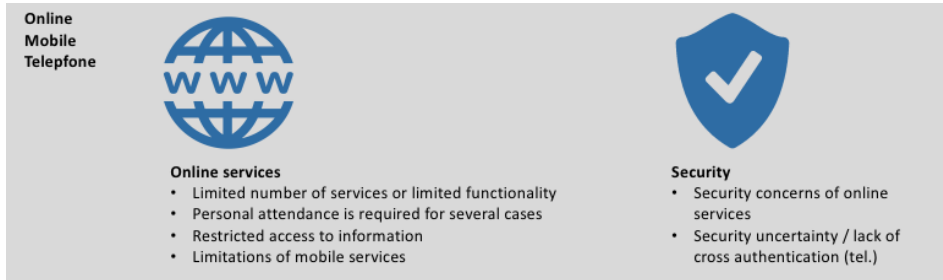


Figure 4: Challenges related to electronic channels

Suggestions made up during Ideation phase and tested in Experimentation phase:

- Let multichannel administration be possible: It is almost inevitable for a bank to be present in a professional manner on all platforms (telephone, online and mobile applications). In our research we have seen examples where the mobile platform was only like a minor advertising space, without meaningful services.
- Let the cases be traceable online: It supports customers' need for transparency, if the ongoing issues (transactions, orders, transfers) - regardless to the channel they were initiated - can be monitored online, grouped by issue areas or chronologically.
- Provide adequate, professional support to online channels: In the back office of online and mobile applications there are no clerks - because of these channels nature. But if the customer gets stuck, or has questions, it would help them a lot if there is an opportunity to redirect to a more personal channel: online chat, video call, call centre. In addition, because the customer has been authenticated online, no other authentication should be performed again during the transition to the new channel. This solution can reduce the number of lost cases.
- The customer should be a partner in security issues: Even though the issue of bank security belongs to the banks, a significant proportion of fraud attempts are targeting customers' credulity. To prevent this, banks should improve customers' security awareness and manage their business transparently.

In Evolution phase, teams were making project plans to solutions which were targeting existing mobile applications without meaningful functionality, or to a augmented reality branch, where customers can manage their issues in the well-known environment of their own branch, with professional clerks as avatars, using internet-based telephony.

4.3 Products and services

Regarding to administration in branches, the interviewed and examined customers highlighted in Discovery phase the lack of transparency in the bureaucracy of banking, and that there is a lot of paperwork with all issues (Figure 5). The loan and investment administration turned out to be the most effected with the problem, that the rules and the processes laid down by banks are too complex, complicated and incomprehensive for customers. Customers typically get information from these rules and processes from clerks during the administration - and sometimes different clerks give different information to them for the same issue. That is a common customer complaint that the rules seem to be articulated in a way that the customer may not understand or do not want to understand them.

Banks must meet several legal requirements and a significant part of these apply on the cooperation with customers, so the banks have no other option than to enforce the rules applicable to customers. This make the rules and the banking operations for customers - but often also for the clerks - difficult to understand, and what is even worse, following the legislative changes the rules and processes are frequently changing as well. Because of the above mentioned, the customers - regardless of the intention of the banks – can feel that they are at the mercy of these institutions. From the bank's side, ensuring customer experience is becoming more challenging and this can lead to churn of customers. This is one of the most important findings from Interpretation phase.

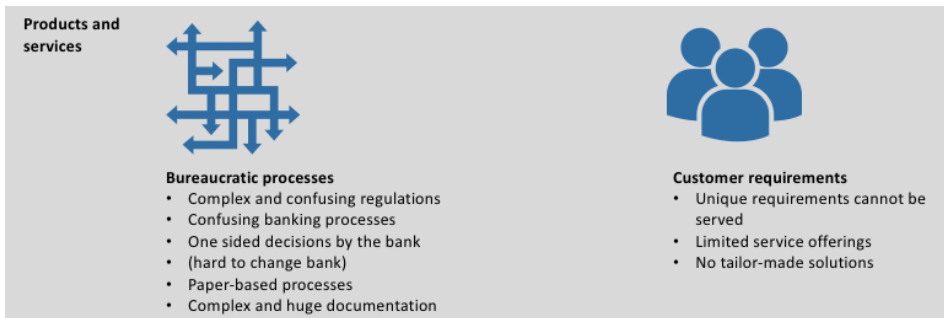


Figure 5: Challenges related to products and services

The extent banking services can be customized or personalized, which is also part of the customer experience. Many customers have indicated that there are only a few options of banking services available, and they cannot find those services that meet their own, sometimes not so unique needs. Therefore, if they can find appropriate services in another bank, they consider the possibility of switching banks.

Suggestions made up during Ideation phase and tested in Experimentation phase:

- Simplify banking procedures, increase transparency: the intricately worded rules do not favour the creation of a trust. It should be clear, what are the responsibilities and tasks of the customers, and what are the responsibilities and tasks of the banks. Use visualization elements, process models and flow charts for better understanding. Use the processes, process models as the base of policies and rules, with clearly defined responsibilities. Simpler and more transparent processes increase the efficiency of processes (faster throughput, less errors), and customer satisfaction.
- Personalized and proactive services based on the analysis of banking data: Based on the customer transaction data, banks have extreme amount of information about customers' life: income, spending, spending habits. Based on these, banks can offer opportunities to customers proactively.
- Banking portfolio expansion with non-banking products and services: As the traditionally non-financial service providers enter the market of banking services, so should the banks open up to non-financial products: travel, commodities and insurance products. The challenge, however, is that the sales effort of these new products should not bother customers in any of the sales channels.

From Evolution phase, a project plan visioning an online bank, where personalized advertisements can be seen (not only in the field of banking) based on the data gathered from the chronologic and personal data from the customer is important to mention.

5 Conclusion

Although most bank realized the importance of digitization, customer centric approaches are quite new in the Hungarian banking sector. Development is not only a technological question (just copying existing solutions from more developed regions, e.g. USA, Western Europe, of SE Asia), but also a methodological one. In our research we demonstrated a useful, rapid, very focused approach of explore customer challenges, but for a successful project we required a good, and prepared team members. The two coaches were able to provide adequate methodological support.

The findings of the project were discussed with the participated banks, given them better insights of customer-centric approaches, through defining the demand. But additional challenges also pressurise banks to develop their systems: eIDAS compliance, PSD2 challenge, GDPR regulation. It is a limitation of this research, that its focusing only on customer (individual customer) related challenges, that mainly visible in front office services. But for Hungarian banks, they have the opportunity to apply matured solutions and technologies: what is still innovative on the Hungarian market, that is already tried out on other market, and we can know the success and failure stories. Therefore, it is important to benchmark the international market, even before deciding on

implementation. Moreover, findings in this research are only a start for further researches, but it was considered a good way to set the basis for further investigations. It is a strategic choice of the incumbent banks, how to manage their relationship to FinTech companies. They can be considered as competitors, as possible partners to work with, but we have also seen a Hungarian bank, that itself developed a Fintech Incubator program. Fintech companies are considered either partners or competitors, but they definitely increase the competition in the sector, and support the digitization efforts.

Generally, the applied research identified several customer challenges and offered also several possible digital solutions. Although the project teams couldn't finish complete, detailed, ready-to-ship products, they made rapid progress, generated and designed a huge number of ideas, and they tested if they are headed in the right direction.

In future researches we would like to expand the size of the research: the used one-week-spring approach should be expanded with additional surveys to validate the findings, and to generalize the results.

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Use of Facebook and Google Platforms for SMEs Business Model Innovation

RIMANTAS GATAUTIS, ELENA VITKAUSKAITĖ & MARK DE REUVER

Abstract Development of information communication technologies brings increasingly more opportunities for optimising various processes and activities of organisations. In the case of platforms, such as Facebook and Google, it is especially relevant to small and medium-sized enterprises. SMEs can adopt ready-to-use information communication technology solutions provided by those platforms for different aspects of their business. The paper aims to find out how SMEs use possibilities of such platforms to innovate business models. Two cases of Lithuanian SMEs are analysed to check the theoretical assumptions summarised in the paper. The case analysis indicates, that use of the platforms contributes to reaching (new) target customers, making adjustments to value propositions, maintaining customer relationships, channels, and thus becoming key resources and supporting key activities, therefore become key partners.

Keywords: • Platform • Business model innovation • Facebook • Google •

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1 Introduction

The development of information communication technologies brought various opportunities and prospects for small and medium enterprises. Very often SMEs are described as slower adopters of innovative information communication technology solutions (Gatautis & Vitkauskaitė, 2009) in comparison to large companies, which have capacity and possibilities to develop and adopt the latest ICT-based innovations. Such situation is caused by the lack of knowledge, strategic forecast, and finances.

Facing such situation, SMEs tend to use information communication technology solutions, which can be provided by third parties and third parties take care of the solutions. Such solutions might be provided on various platforms, which offer new opportunities for SMEs.

Recently a growing discussion about platforms, their development, and their business models has been observed. These discussions as well as related research address how platform business models might be developed and how successful platform business models are run. However, SMEs usually act as users of the platforms in order to fulfil their needs and gain an advantage in the market.

The success of the company is determined by defining and implementing the business model that allows understanding the key aspects of the success. In order to sustain long-term advantages, SMEs should innovate their business models in response to the changing market conditions, i.e. find new ways to expand their value propositions, find new markets and segments. Use of platforms provides various options for SMEs. According to researchers, companies need to consider platforms such as Google, Facebook, Amazon, Apple (Simon, 2011; FaberNovel, 2014, Miguel & Casado, 2016).

Our research aims to contribute to understanding how SMEs use platform possibilities to innovate business models and how these decisions are made. SMEs make strategic decision to deploy various platforms as they provide different opportunities, e.g. Google and Apple help to reach customers, Facebook to develop relations, Amazon to use more effective services. The research presented in the paper aims to understand how SMEs evaluate platform possibilities, how the needed functionality of the platform is selected, how SMEs change the business model and how SMEs assess the success of business model change.

The four platforms (GAFA – Google, Apple, Facebook, and Amazon) in particular become important partners in business to consumer markets as GAFA takes about 55 percent of user digital life (FaberNovel, 2014). The phenomenon, when new companies appear online by using only the infrastructure of GAFA are also observed. In this paper, we contribute to the research body by analysing the use of Google and Facebook products for business model innovation among Lithuanian SMEs.

2 Business Implications of Digital Platforms

The term “platform” has been attracting the attention of practitioners and researchers in the last decade. The term became so popular that practitioners and researchers started using a new term “platform economy” (Accenture, 2016).

Initially, the term “platform” was defined as “digital infrastructure (hardware and/or software) on which different applications can be run, or (by wider definition) allowing for a finite and clearly defined set of uses” (Andersson Schwarz, 2015). Techopedia (2017) suggests the following definition: “a platform is a group of technologies that are used as a base upon which other applications, processes or technologies are developed.” This approach is clearly related to the technical point of view as key characteristics of platform refer to hardware/software aspect and clearly defined set of action. Such definition addresses Google or Facebook platforms at the beginning of their activities as Google served as search engine allowing users to find information, while Facebook served as communication tool providing an attractive and simple way to socialise.

However, due to the development of technologies and more active role of platforms in the digital economy, the new term “platform company” appeared. The term aimed to describe company offering a platform or several platforms aiming “to provide marketplaces, distribution of media content, and/or coordination of activities” (Andersson Schwarz, 2015). This definition demonstrated managerial approach emphasising functionality which platforms were offering as a key value proposition. Ballon (2009) even suggested the term “platformisation” referring to new societal trend when companies are developing and offering platforms, and new platform-based business models appear.

Platform phenomenon became popular and new term “platform economy” appeared. According to Kenney and Zysman (2015), platform economy is “one in which tools and frameworks based upon the power of the internet will frame and channel our economic and social lives.” Authors identify four essential elements that ensure the functioning of platform economy: infrastructure, training and skills, social protection, and regulatory transition.

The growing importance of platforms was also addressed during World Economic Forum 2016 by outlining the importance of platforms for companies and organisations, naming disruption of economic activities, lower market entrance barriers, and in some cases changes to the logic of value creation, capture and transfer to market (World Economic Forum, 2016).

As companies face new challenges in adopting platforms these challenges mainly refer to functionalities platforms offer. Companies using platforms (assets developed by other companies) can dedicate more focus for business development and business differentiation. As platforms act mainly as facilitators, companies need to understand how

to adopt platforms in their daily activities and how to measure the value platforms bring to their business.

The growing number of platforms also indicates the differences between the platforms. Some platforms are oriented to reach consumers (e.g. Google), some facilitate communication and provide services (e.g. Facebook), some facilitate trade (e.g. Amazon). In many cases, platforms act as facilitators enabling companies to enhance value proposition and optimise their activities, but the value for both parties (companies and users) are created through orchestration.

Platforms also might be described as “frameworks that permit collaborators – users, peers, providers – to undertake a range of activities, often creating de facto standards, forming entire ecosystems for value creation and capture” (Kenney & Zysman, 2015). Gawer and Henderson (2007) suggested an approach to defining a product as a platform. According to Gawer and Henderson (2007), a product is a platform when “it is one component or a subsystem of an evolving technological system, when it is functionally interdependent with most of the other components in the system, and when end-user demand is for the overall system, so that there is no demand for components when they are isolated from the overall system.” Platforms might be described by several important components (Hagel, 2015):

A governance structure, including a set of protocols that determine who can participate, what roles they might play, how they might interact, and how disputes get resolved. An additional set of protocols or standards is typically designed to facilitate connection, coordination, and collaboration.

There are different platforms such as Intel, Microsoft, Cisco. Faber Novel (2014) suggest four main platforms: Google, Amazon, Facebook, and Apple. Accenture (2016) names several platforms in various areas: Fiat (connected car), Kaiser Permanente (digital health), Disney (MagicBands), Caterpillar (connected machines), Schneider Electric (smart cities, buildings, and homes), Walgreens (retail pharmacy), Goldman Sachs (customer analytics), Bank of New York Mellon (financial services), McCormick/Vivanda (FlavorPrint), Houghton Mifflin Harcourt (education).

Venkatraman et al. (2014) outline several important platform characteristics which create implications of innovations for SMEs, namely scale, scope, and speed. Besides these characteristics, platforms challenge SMEs operational, dynamic and improvisational capabilities and lead to internal changes within the company. As platforms play a major role in value creation, capture and transfer, platforms became a major factor affecting the business model design of companies.

The business model concept became popular in last decade, and many researchers deeply investigate this area. The business model can be defined as “description of how an organisation or network of organisations intends to create and capture value from offering

a service to its customers” (Bouwman et al., 2008). Despite growing popularity, business model research area attracts academic exploration as according to Teece (2010), this area resides somewhere between economics and business strategy and more elaborated research is needed. The related area is business model innovation, which according to Spieth et al. (2014), remains “a slippery construct to study” (Casadesus-Masanell & Zhu, 2013). Within our research context, it is considered that platforms bring new opportunities for value creation and capture, and companies need to rethink their business model logic. This refers to business model innovation concept, which can be defined as “changes in business logic that are new to the firm, yet not necessarily new to the world, and have to result in observable changes in the practices of a BM” (Bouwman et al., 2008).

3 Research Framework

There are many approaches to business model analysis. One of the most popular approaches widely accepted by practitioners is Business Model Canvas (Osterwalder & Pigneur, 2010). This approach defines key components of the business model: value proposition, customer segments, channels, customer relations, key activities, key resources, and key partners. As a consequence, decisions regarding these components result in revenue streams and cost structure.

In our research, we decided to address two important platforms, namely Facebook and Google. Facebook is easily identified as a platform and companies might obtain various services through “one-stop shop” approach. Google situation is different as Google offers several different services and use of these services causes some confusion for SMEs. SMEs are interested in using such products as AdWords, increasing their position in Google search listing (SEO), use a Google Drive.

The comparison between traditional business versus opportunities of Facebook and Google platforms for business model innovation is presented in Table 1.

Table 1: Google and Facebook platforms opportunities for business model innovation

Business model component	Traditional	Google platform	Facebook platform
Customer segments	SMEs serve mass market (no segmentation) or apply geographic, demographic or psychographic segmentation criteria, rarely behavioural criteria.	Most of Google products are based on interest in a certain topic, therefore, enabling segmentation based on the interest of potential customers. Good opportunities to reach niche markets.	Segments might be targeted based on demographic, geographic, and behavioural criteria, as well as interests. Good opportunities to reach niche markets.
Value propositions	Entirely up to the company	Change value proposition based on better understanding of customer needs. New value proposition for business (AdSense).	Enhance value proposition through: Change value proposition based on better understanding of consumer needs. Provision of additional information.
Channels	Different physical channels, such as traditional media points of sale, agents, website, e-shop.	Might serves as the main channel for attracting consumers attention. Mainly for raise awareness and evaluation of alternatives.	Channel for attracting consumer attention and delivering additional value. Might serve for purchase, delivery and after sale services.
Customer relationships	Personal service Self-service (e-shop)	Trigger to initiate interactions with customers	Personal service (e.g. after sale service) Community / Social support
Key resources	Infrastructure Materials Knowledge/HR	Google tools for business (e.g. Drive, Mail)	Information on customers and their social behaviour

Business model component	Traditional	Google platform	Facebook platform
Key activities	Production or service provision Sales Marketing/advertising	Collecting of information about customer needs (CRM) Marketing and advertising	Additional value delivery Relations management Marketing and advertising Sales activities
Partners	Recourse suppliers, infrastructure providers, intermediaries	Might serve as supporting service supplier	Might serve as one of main service providers

Platform adoption is strongly driven by the spread of ICT and many new start-ups adopt platforms for the benefits platforms are offering. Considering such situation, many entrepreneurial SMEs also move towards platform adoption, as this should give them the opportunity to run the business more efficiently.

Research method. An analysis of several cases of Lithuanian SMEs using Facebook or Google in their activities was carried out. No distinction was made if SMEs use a platform by themselves or are they supported by business consultants. We believe, that even if SMEs use consultant services they understand benefits of platforms well enough as SMEs invest in the utilisation of the platform.

We tried to identify SMEs using Facebook or Google platform. In many cases, we found it complicated as SMEs tend to use both of them, but we identified cases there one platform is key platform and use of the second platform is limited, and therefore the role of the specific platform is more expressed.

Interviews were carried out with SME representatives that are most knowledgeable about the use of a given platform within their organisation. Additionally, an observation of actual use of a platform was carried out where possible (e.g. observation of a Facebook page).

4 Empirical Findings

4.1 Case 1. Use of Facebook Platform

UAB *Socialinis institutas*, and more specifically their brand *ačiū pačiū*, was identified as SME case with the use of Facebook platform for business model innovation. Interview was carried out with the marketing manager of the company (direct quotes from the

interview are used in case description thereafter). Observation results of the Facebook page of the brand were also used for this case description.

UAB *Socialinis institutas* is a socially responsible company that produces and sells toys for children. All products are handmade and produced from natural materials. The company focuses not only on offering high-quality products but also at reducing social exclusion by providing employment to socially vulnerable people with physical disabilities. Over 60% of employees are disabled people. Those employees sew the toys and carry out other sewing assignments as the company takes orders for various sewing services, such as sewing tablecloths and other items.

The company is developing its toy brand *ačiū pačiū*, and expects that in future the brand toys will become the main product of the company, and there will be no need to take orders for other sewing services.

For online marketing, the company uses an e-shop <http://www.aciupaciu.lt> (in Lithuanian), e-catalogue, and Facebook page (<https://www.facebook.com/aciupaciu/>). They also plan to start using the Instagram account. The company also writes articles, but rarely.

The primary reason to start using Facebook was the fact that Facebook was the cheapest and easiest to use way to reach the target customers of the business. At the beginning of the business it was important that the means used would allow reaching customers without larger investments.

The other important reason was the responsiveness of the customers, as “it is significantly easier to communicate with them here and now”. It was noticed by the company, that customers nowadays find it simpler and more convenient to write a Facebook message than to write an e-mail. That was important to the company, as they want to be accessible to customers, have personal communication with them, and to have the opportunity to offer personalised products. Facebook provided a platform enabling that kind of communication. Compared to other social media platforms, activity on Facebook achieves the highest engagement from followers.

Key features of the Facebook used by the company are: the Facebook page of the brand, instant messaging function, paid advertising options (boosting of the posts, ads for driving leads to the website, carousel ads). Facebook page is administered by an external agency, while the company itself maintains the content.

How platform affects business model innovation? First of all use of Facebook enables the company to reach its *target customers*. In fact, company representative claims that “if not Facebook, I do not know how else we would have reached the customers at that moment when we needed that.” Facebook enabled the company to reach new customers as well.

The company was targeting people from Lithuania. However, they soon discovered getting orders from abroad as well.

Facebook is also used as a source for modifying the product, namely the core of the *value proposition*. Personalised and customised products are offered to customers based on personal communications with them via Facebook messenger. Also, the company uses feedback from their Facebook community to make decisions regarding the products (e.g. asking an opinion about colours of products, or about other features). The latter option is rarely used, however. The communication with the community on Facebook helped the company to understand that customers prefer simple products and designs. “Whenever we placed a more unusual or interesting offer and expected people to prefer it, they would surprise us by choosing more simple and basic option. That helped us to provide more relevant products to our customers.”

Facebook page is used as one of the main *channels* to raise awareness of the products, by introducing and promoting novelties. Advertising possibilities are used for this, e.g. every post is boosted for few days by targeting target customers of the brand. As mentioned, it is also the main channel to communicate with customers. Therefore, to provide post-sales support as well (e.g. “if a customer found out that a piece of child’s clothing she bought does not fit the child, we usually resolve the issue very fast and easy by communicating on Facebook. Another example if a customer is not sure how to wash a toy he bought, we easily provide him with the information”).

Facebook is also a crucial platform for maintaining *relationships* with customers. The messenger is used for personal service, to chat with customers, answer their questions, to find out their requests and preferences. Community (close to 15 000 fans, as of March 2017) relations are also maintained on Facebook page of the brand.

4.2 Case 2. Use of Google Platform

The company *Transer* was identified as SME case with the use of Google platform for business model innovation. Interview was carried out with one of co-owners of the company (direct quotes from the interview are used in case description thereafter).

The company *Transer* offers translation services for technical text (<http://www.transer.net>). The company is SME and have five persons directly involved in company activities. There is an extensive partner network as the company hires different interpreters for specific tasks. The company revenues reach about 100K euro per year in the last three years, and according to company CEO, revenues are stabilised. There is no specific reason why Google platform was selected, but the decision is based on a variety of information available in newspapers and journals about Google benefits for business. The first attempt to use Google platform was in 2010 trying to reach a larger number of customers via PPC advertising (Google AdWords). However, this initiative was not successful for several reasons. First of all, the company lacked knowledge and

skills to manage PPC campaigns effectively. The second reason refers to competitor behaviour as competitors intentionally were clicking on company advertising and company advertising did not attract visitors to the website.

The second attempt to use Google products was much more successful. This time it was decided to use Google Drive and Google Documents in order to save costs and make internal operations more efficient. According to the company owner, the ability to use documentation in a more comfortable way was the reason to start. “I use two separate computers – one in the office and another one at home. Typically, in a rush, I forget the documents, and it means I cannot access them because documents are on another computer. By using Google Drive/Documents, I can access all documents from any computer.”

The next step in using Google platforms was to use Google Documents on various cooperation tasks. “As we realised we can all use the same document, we started using this solution for implementing some activities.” After successful use of Google Documents, the company decided to replace CRM system with Google Documents.

The attempt was made to share information through Google Documents with partners/interpreters, but it was not successful. Interpreters preferred to call or send email, but not use online documents.

How platform affects business model innovation? The company used Google platform for several business model innovations, but only one of attempts was successful.

The first attempt was to reach new segments and *new customers* using Google AdWords, but the lack of knowledge did not result in a desirable outcome. The attempt to use AdWords lasted just for several months.

Second attempt related to the optimisation of internal operations and affected *key resources* and *key activities*. The Google platform improved internal operations and became part of company infrastructure. As a consequence, the company decreased costs around 500 euro per year. Those are not significant savings, but company CEO considers them as important ones.

5 Discussion

From the theoretical research, assumptions were made on the contribution of Facebook and Google platforms on business model innovations. Based on interviews with SME representatives we might state that the impact of Facebook is easily recognised and valued by SMEs as Facebook acts as one-stop-shop. It is more complicated to determine the impact of Google products from SMEs perspective as Google offers various services which might be used by different departments. Facebook platform is perceived as a marketing tool mainly, and in the case of Google, only some features are related to the

marketing function. Some of Google tools (Documents, Drive) are used entirely for companies internal operations.

From case studies, we observe that platforms are used for reaching (new) target segments. In the case of Facebook, this associated with a “typical feature” of modern brand and company successfully maintains its presence on Facebook. From the perspective of Google platform, AdWords were used to reach target segment. However, the company did not manage to do it appropriately as lacked skills to use AdWords.

We also find out that companies can successfully use Facebook platform as communication tool allowing to customise value propositions. Facebook messenger plays a major role in getting information about small details of a product (such as colour, shape). Therefore, Facebook Messenger plays an important role in building customer relations.

We also observed that platforms (especially Facebook) might act as one of the main channels ensuring information flow and communication between company and target segment.

As Google platform offers features targeted towards various activities of companies these features are used to make companies performance more efficient. We observed a case then Google Documents are used for operation coordination and customer relationship management, so the impact of Google platform on key activities is significant.

None of the companies referred to platforms as partners, but it is evident that both platforms (Facebook and Google) play an important role as partners (namely providers of services and infrastructure suppliers) in activities of companies.

6 Conclusion

Platforms play a greater role in SMEs activities as they give new opportunities for SMEs to innovate in the context of a business model. SMEs typically approach the four main platforms – Google, Apple, Facebook, and Amazon. Some platforms act as one-stop-shop offering different functionalities (Facebook, Amazon), some platforms offer features that are distributed (Google, Apple).

Platforms can bring opportunities for innovation in all business model components. Target customers affected through reaching (new) customers. Value proposition through offering customisation. Channels through acting as the main channel for raising awareness and post-sale support. Customer relations by ensuring personal and real-time communication. Key activities and key resources through functionality and tools provided. As a result, those platforms might even become key partners.

Analysis of the use of Facebook and Google in Lithuania SMEs indicate adoption of the platforms for a few of business model innovations. Facebook and Google platforms were used to reach (new) target customers. Facebook was also used for customisation of value proposition, as a channel and for customer relations development. Meanwhile, Google products were used for innovation of the key activities component.

None of the companies recognised platforms becoming important partners, but platforms role as key partners was observed.

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The Impact of Clinical Information Systems on Patient Outcomes and Organisational Performance

PETER HADDAD, JONATHAN SCHAFFER & NILMINI WICKRAMASINGHE

Abstract We are witnessing significant investments by the healthcare industry globally in information technology (IT) to enhance patient outcomes, safety, efficiency, and financial performance. However, unlike other industries, the complexity of healthcare confounds the evaluation of the business value of these IT solutions and thus to date it has been difficult to clearly articulate the true business value of IT in healthcare contexts. This exploratory study addresses this problem by examining three clinical IT systems in the Australian healthcare context: a nursing documentation (ND) System, a computerized physician order entry (CPOE) solution, and an Incident Reporting System (IRS). The results indicate that these systems have the potential to provide better business value and have direct and indirect impacts on patient outcomes, efficiency, safety, and the overall performance at different levels, depending on a multiplicity of factors all of which need to be considered.

Keywords: • Healthcare • Information Systems • Clinical IT • CPOE • Nursing Documentation •

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1 Introduction

Optimal healthcare access, quality and value have become global priorities for healthcare domains to combat the exponentially increasing costs of healthcare services (Huang, Seitz, & Wickramasinghe, 2010; Porter, Pabo, & Lee, 2013). Information systems/information technology (IS/IT) have been promoted as a critical enabler to achieving these priorities (Kenneally *et al.*, 2013; OECD, 2010a, 2010b). Presently, we are witnessing a staggering range of IS/IT applications in healthcare that have promised to deliver higher quality and safety with greater value (Wickramasinghe & Schaffer, 2010). However, the data supporting these claims is often lacking or poorly supported (Melville, Kraemer, & Gurbaxani, 2004; Lemai Nguyen *et al.*, 2015). Advocates, in particular, point to the potential reduction in medication errors as a critical advantage (Radley *et al.*, 2013; Vermeulen *et al.*, 2014). These singular advantages do not reflect the enterprise viewpoint that is so needed (James, 2013). Further, the debate about the difference IS/IT solutions can make to healthcare quality, efficiency, and safety has only intensified (Buntin, Burke, Hoaglin, & Blumenthal, 2011; Jones, Rudin, Perry, & Shekelle, 2014). In the light of these complex circumstances, there is a critical need for a framework to evaluate the business value of IS/IT in healthcare (Haddad, Gregory, & Wickramasinghe, 2014).

Previous research (Haddad, Schaffer, & Wickramasinghe, 2015; Haddad & Wickramasinghe, 2014, 2015) has discussed examining the business value in healthcare IT by leveraging four groups of IS/IT according to their business. These groups classify IS/IT into infrastructural, transactional, informational, and strategic domains (Weill & Broadbent, 1998). Socio-technical aspects (Muhammad, Teoh, & Wickramasinghe, 2013) with healthcare projects are also important to consider. Thus, they are mapped in previous work with the different layers of healthcare delivery including healthcare ecosystem, system structure, delivery operations, and clinical practices (Rouse & Cortese, 2010).

This research evaluates the developed model of The Business Value of IT (BVIT) in Healthcare (Figure 1). This model was designed to help evaluate the business value of IT in healthcare (Haddad *et al.*, 2015; Haddad & Wickramasinghe, 2014, 2015). The model itself takes technical and socio-technical perspectives in mind. The former is presented by the work of Weill and Broadbent (1998), which classifies IT investments into four categories based on their business objectives (infrastructural, transactional, informational, and strategic), while the latter is presented by the work of Rouse and Cortese (2010) which classifies various healthcare delivery activities into four levels, namely healthcare ecosystem, system structure, delivery operations, and clinical practices. Specifically, three clinical IT systems at both private and public healthcare settings in Australia were evaluated. The first system is an American made computerized physician order entry (CPOE) system. The second is an Australian made nursing documentation (ND) system, while the third is an Australian made incident reporting system (IRS). The selection of these systems was based on their characteristics as they address the needs of different stakeholders i.e. the ND system helps streamline the

workflow of nurses, the CPOE helps oncologists (a more specialised clinical group than nurses) to manage cancer medications, and the IRS is meant to be use by all of the hospitals' staff to report incidents. Testing these systems in two different settings serves two purposes: 1) Data triangulation and findings validation and 2) Impact assessment of two different elements in the Australian healthcare ecosystem (private and public healthcare providers) on generating business value from clinical IT.

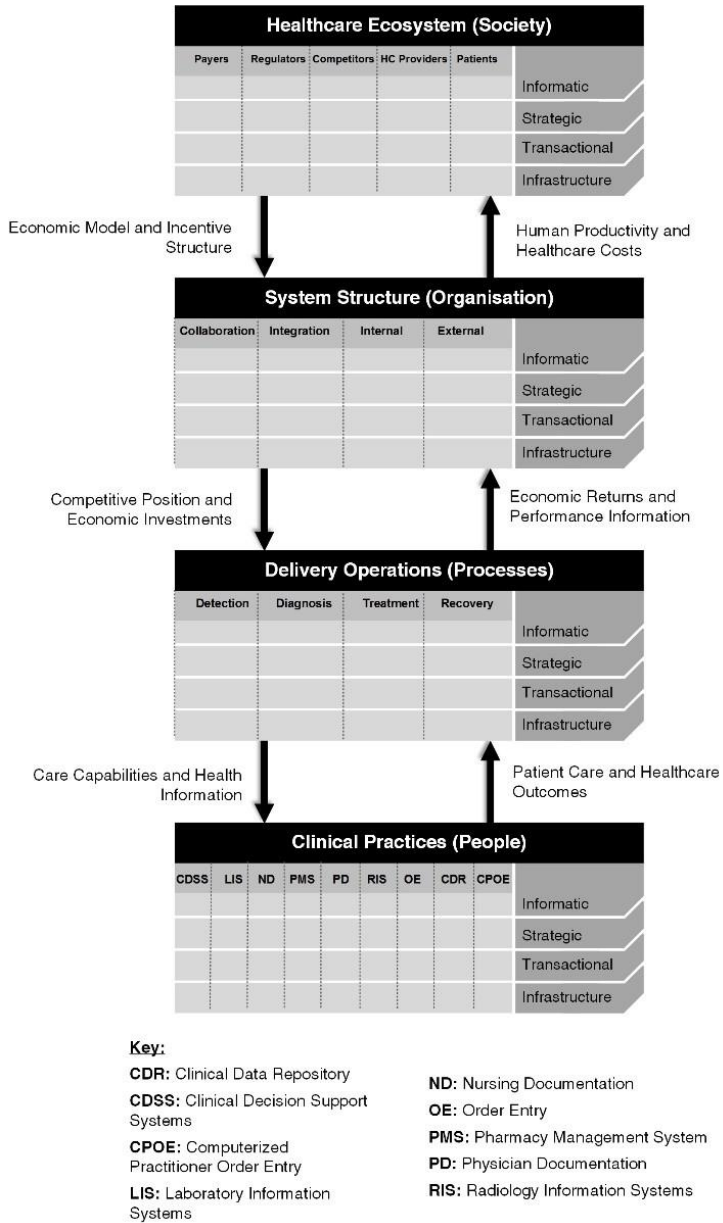


Figure 1: The Model of Assessing Business Value of IT in Healthcare

2 Methods and Settings

A multiple case study approach was adopted, as this enables contrasting results for predictable reasons to enhance the generalisation to other case studies (Baxter & Jack, 2008; Yin, 2014). Two case studies were used in this study. The selected cases were chosen based on 1) the volume of IT investments they both made during the last 5 years, 2) their nature (one is public and the other is private) to help identify any differences could result as a result of differences in care delivery models, and 3) having vast ranges of clinical specialties. The first is ABC Hospital, a Victorian public hospital established in 2000 and provides care for more than 750,000 people. ABC Hospital has been providing around one million episodes of patient care each year through the efforts of about 10,000 staff. ABC Hospital provides a comprehensive range of clinical services and high-quality acute, sub-acute and palliative care, mental health, drug and alcohol services, and residential care, community health and state-wide specialist services to people and communities that are diverse in culture, age, socio-economic status, population and healthcare needs.

The second case study is XYZ Hospital, which is a private hospital and counted as one of the largest not-for-profit private healthcare groups in Australia. With seven sites and two rehabilitation centres, XYZ Hospital has invested more in IS/IT during the last few years than in the past and hence was one of the reasons they were chosen to be included in this study. According to the Chief Financial Officer (CFO), approximately 30% of the capital budget during the last five year was set aside for IT investments in business, infrastructure and clinical systems.

Three clinical IT systems were examined; the ND, IRS and the CPOE systems. The ND system was studied within ABC and XYZ hospitals, while the IRS and CPOE systems were studied solely within XYZ Hospital.

Prior to conducting the data collection, all ethics approvals had been acquired from both hospitals. For the ND system two sources of data were used; survey¹ data collected from ABC Hospital (two sites A and B), and semi-structured interviews at XYZ Hospital. First, the survey was distributed pre and post implementation of the ND system and consisted of six sections. The survey used the unified theory of technology acceptance and use of technology (UTAUT) as the studied ND system is a new system. The survey consisted of:

- Items related to performance expectancy (PE) (8 questions in this group)
- Effort expectancy (EE), (4 questions)
- Social influence (SI) (5 questions)
- Facilitating conditions (FC) (4 questions)
- Voluntariness (V) (3 questions)
- Behavioural intentions (BI) (5 questions)

UTAUT was used as a technology acceptance model to uncover intentions of users regarding the use of a new system. Inclusion criteria for the survey was: 1) being a nurse, 2) worked for more than 5 years in similar settings, and 3) willingness to participate in the survey. The survey used the lens of UTAUT, and was validated using extensive discussions with academics and experts in the healthcare domain. Required changes were made accordingly. This method is widely used to measure the different aspect of interaction between human resources and health IS/IT, see for example (L. Nguyen *et al.*, 2015; Oshlyansky, Cairns, & Thimbleby, 2007; Taiwo & DOWNE, 2013; Williams, Rana, Dwivedi, & Lal, 2011).

Due to the nature of nurses' duties, and to our intention to gain instant understanding of how the nurses found the investigated system, a hard copy of the survey was prepared and provided to nurses at the completion of their shift. Those who met the criteria across two sites at ABC Hospital were 39 in site A and 48 in site B with response rates of 60% and 70% respectively.

Due to the complexity of the CPOE and IRS systems, and given they both were new during the data collection phase, 23 semi-structured interviews were conducted for healthcare better understanding of the possible business value of these systems. From these interviews specific themes emerged (Pope & Mays, 2013) with critical information and insights from three major groups of professionals in the healthcare industry: executives, clinicians (physicians), and IT personnel. Selecting the participants was based on their role and/or affiliation with the group, as well as their level of interaction with IS/IT investments and projects. The first protocol for the interviews was reviewed by conducting three pilot interviews with medical and IT experts. This phase resulted in a shorter and more focused protocol. Three questions were deleted as they had been designed to ask about systems that never existed in the case study (Yin, 2014), and two questions were added to explore insights from clinical IT experts, i.e. clinical people who are IT savvy. After modifying the interview protocols, the main interviews took place. All of the interviews were audio recorded with full permissions from interviewees, professionally transcribed, verified, and then qualitatively analysed using QSR Nvivo 10 software (Bazeley & Jackson, 2013). Data collected from these interviews were analysed also to understand the business value of the studied systems. These interviews were also used as a primary source of data about the CPOE and IRS systems (Table 1).

Table 1: Research Design

System	Setting	Method	Data Sources	Participants
IRS Australian system	Private (XYZ Hospital)	interviews	23 Semi- structured interviews	Physicians Executives IT personnel
ND Australian system	Private (XYZ Hospital)	interviews	23 Semi- structured interviews	Physicians Executives IT personnel
	Public (ABC Hospital)	UTAUT based online	UTAUT survey	Nurses
CPOE American system	Private (XYZ Hospital)	interviews	23 Semi- structured interviews	Physicians Executives IT personnel

3 Results

Data analysis was initiated by mapping the three systems using the Business Value of IT in Healthcare model. Based on their functionalities, the studied systems were classified as informational IT, which provides information for managing and controlling the firm, as well as supporting decision making, communication and control (Weill & Broadbent, 1998). These systems, though, have other components from the IT Portfolio as Table 2 depicts. For example, the CPOE system is informational in nature, as it helps produce and share information on treatment plans and medication scheduling. However, it has a transactional component, which enables data entry/input like identification, progress notes, medication scheduling, discharge checklist, and treatment plans. In addition, it utilises the IT infrastructure like Internet, Intranet, workstations, servers, and databases. Table 2 also shows the different layers of healthcare delivery from a socio-technical perspective.

Table 2: Mapping the Three Studied Systems to the BVIT Model

Perspective	Components	ND	CPOE	IRS		
IT Portfolio	Infrastructure	<input type="checkbox"/>	Internet, Intranet, Computers, Servers, Smart devices in wards and at nurse stations, databases	<input type="checkbox"/> Internet, Intranet, Computers, Servers, Databases <input type="checkbox"/> Internet, Intranet, Computers, Servers, Databases		
	Transactional	<input type="checkbox"/>	Data entry/ input, like Vital signs Fluid balance charts Pain assessment Identification Progress notes Wound care Medication	<input type="checkbox"/> Data entry/ input, like Identification Progress notes Medication scheduling Discharge checklist Treatment plans <input type="checkbox"/> Data entry/ input, like Incident details Level of reporting Actions required Destination of information		
	Informational	<input type="checkbox"/>	Facilitating information sharing within different craft groups rather than using paper records	<input type="checkbox"/> Producing and sharing information on treatment plans and medication scheduling <input type="checkbox"/> Facilitating real time information exchange among different departments and personnel		
	Strategic	X		<input type="checkbox"/> Smart medication scheduling X		
Healthcare Delivery	Healthcare Ecosystem	<input type="checkbox"/>	All of the systems work in the Australian healthcare ecosystem. The only difference is one is being implemented in a private hospital (CPOE and IRS) and the other is being trailed and tested in both private and public hospitals.			
	System Structure	<input type="checkbox"/>	All of the systems require reengineering healthcare processes to help generate business value. This includes both internal and inter-organizational processes.			
	Delivery Operations	X	Detection	<input type="checkbox"/>	Detection <input type="checkbox"/>	Detection
		X	Diagnosis	<input type="checkbox"/>	Diagnosis <input type="checkbox"/>	Diagnosis
		<input type="checkbox"/>	Treatment	<input type="checkbox"/>	Treatment X	Treatment
X	Recovery	<input type="checkbox"/>	Recovery X	Recovery		
Clinical Processes	ND		CPOE	IRS		

3.1 The CPOE System

The CPOE system, specialized in oncology care, has three modules focused on radiation, medical, and surgical oncology care. At XYZ Hospital, the radiation and medical modules have been implemented, while the surgical module has not yet been acquired. The aim of implementing this system is to replace the manual patients scheduling with an electronic means on a quest to improving the integration of the cancer care process and eliminating prescription errors.

The radiation module was implemented in XYZ Hospital two years ago, while the medical module has been recently acquired. Globally, the system has been in use in the market for 10-15 years while in the Australian market, it is been in use for 7 years. Investigating the impact of this system showed that CPOE systems have high potential to optimize both patient outcomes and healthcare efficiency by better aligning with care standards and protocols. Since the introduction of this system, “there’s been a significant reduction in errors because we prescribe according to the protocol. These protocols are quite common and human error in prescribing is common. It has enhanced legibility, all that sort of stuff” as one interviewee described. For the financial performance, a number of interviewees expected that the system would enhance the financial performance by receiving more referrals from independent oncologists (visiting medical officers (VMOs)), but this is subject to complex agreements that have to be reached between the hospital and the VMOs and that is beyond the scope of this paper.

3.2 The ND System

The ND system has been envisaged by the developers to replace the paper-based nursing documentation applications in hospital acute wards in both private and public hospitals. The objective of this system is to eliminate time assigned for non-medical duties and allocate more time for patients' care. This is facilitated by putting smart terminals at patients' bedsides, creating more direct interaction between nurses and patients. Providing these smart terminals directly at the bedside should facilitate higher levels of collaboration between ward nurses and other healthcare professionals according to the system’s designers.

Results revealed from the UTAUT survey at ABC Hospital showed that this system increased the time for patient assessment from 5.2% to 9.1% of the total time spent by a nurse during a regular ward visit. This was achieved by reducing the time consumed for nursing documentation from 15.7% to 6.4%. Not only did the care time increase, but also the level of transparency, as patients could witness more details about their care provision, and an extra 48.1% of nursing activities were performed at the bedside compared to the process before introducing the ND system.

The system helped increase patients safety by having a ‘one-stop-shop’ for patient records as one interviewee described. On the other side, a number of interviewees did not see a

direct translation between ‘longer care time’ and ‘better care’. One interviewee noted that it is “much more complex than just taking some aspects of the role away”, and even with this new system “I think that even with our new technology that we’re testing now, nurses find other things to do” as another interviewee explained. The scope of the system is limited to ward and nursing station. This does not allow the system to cover the end-to-end process of healthcare provision as one interviewee noted in their concerns.

In addition, the ND system has demonstrated high potential to increase the healthcare efficiency by reducing the time dedicated for paper records and following patients’ information and records. The nature of the system allows for a “higher number of processes to happen ever than before” as one interviewee noted, which has direct impacts on the efficiency of healthcare delivery through prompts and real time documentation. Also, this system seemed to have some impacts on the clinical decision making process. With all patient data available in the ward in one electronic pool i.e. the ND system, nurses can make clinical decisions or recommendations quicker, and based on more evidence than the paper records as agreed to by the interviewees

The results show that the system may have indirect impacts on the financial performance of the facilities. This is by enhancing the reputation of the hospital through their use of state-of-the-art systems that are visible to the patients. A number of interviewees noted that this system has what was termed “face value”. As a private hospital, reputation is a “fundamental part of the business” as one interviewee described. Thus “if patients feel that even just on face value, that the nurses are not scribbling on a piece of paper, but actually, they’ve got an IT system that provides confidence in the organization”. Other aspects of enhancing the financial performance by using this system included better resource allocation. As the time spent by nurses to perform documentation duties is reduced, nurses are expected to be capable to provide care to higher number of patients.

3.3 The IRS System

This system is used across almost all of Victoria and beyond in large parts of Australia as well for capturing abnormal clinical incidents. It serves two purposes: documentation of an incident at the time it occurs, to support the classification via an inbuilt algorithm into how serious the incident is, and standardizing the information that’s being captured through validation fields, distribution of that information to where it needs to be and then to drive it through into a larger data set of all clinical incidents to support more detailed analysis.

This reporting system is web-based and enables all stakeholders to report different levels of incidents irrespective of their criticality. Along with capturing clinical or non-clinical incidents, the IRS enables sharing information with different levels of management and employees without any delay, as one of the closet administrators of this system explains: “that’s about people anywhere in the organization reporting clinical - or incidents of any sort - that a staff or patient. That’s dependent upon an IT system having someone locally

doing something that's reasonably easy that makes the information available where it needs to be. Off the back of that incident being reported there are potential triggers or alerts launched to people who need to know. So, if it's a staff incident, O.H.S staff knows about it, as soon as it's entered. If it's a very serious incident, all of the senior management and appropriate clinical risk people know about it straightaway. There are some benefits in terms of information provision". This system is relatively inexpensive, simple, intuitive, and easy to use, as a majority of the interviewees agreed during our discussions. These features make this system very popular in the Australian Healthcare context.

XYZ Hospital purchased this system a few years ago to address an obvious gap in the information flow regarding incidents across the hospital as a number of interviewees agreed: "... [without IRS] we will have no capacity to know, or no realistic capacity, to know what things are going wrong with our patients, and therefore the ability to monitor them, to improve them and to attract that improvement".

Using this system has created a 'cultural shift' towards reporting in the group as one interviewee notes: "We've got numbers of things that happened at the time we implemented it. We've seen the cultural shift towards reporting; so increased numbers of incidents being reported not occurring because we don't know what occurred. Then we've seen the severity of those events go down in the time we've used it. Then the frequency of things happening goes down, while we have other indicators implying that reporting is still up". This shift, in turn, has other impacts on the overall performance of the group. A number of the interviewees emphasized that the use of IRS is associated with increased patient safety, healthcare delivery efficiency, as well as reduced cost of healthcare provision: "If we're not having patients stay longer because something went wrong, then it's more efficient. If a patient comes to have a heart operation, and then falls over and breaks their leg, then they stay for another week, have another operation; all of which we potentially are not paid for, so there's a cost imposed. So there are real benefits."

4 Discussion

This study analyses the business value of IT in three specific healthcare contexts. This was done by using the Business Value of IT in Healthcare Model, which builds upon the IT Portfolio model (Weill & Broadbent, 1998) and the Enterprise of HealthCare Delivery model (Rouse & Cortese, 2010). The results suggest that looking at IS/IT solutions based on their business objectives helps identify which IT systems in the healthcare industry may help create more business value for the studied hospitals. Informational IT was shown to be the most relevant category for the healthcare context. This is consistent with the findings of Weill and Broadbent (1998) that informational IT is important to facilitate seamless information flow between different stakeholders. This is particularly crucial for healthcare providers as clinical decision making is a sophisticated process, and most of the time it requires inputs from different craft groups. Thus, finding an electronic platform that provides dashboard capabilities to nurses and other physicians is prudent for today's and tomorrow's healthcare. The results from the interviews showed that information

sharing that is facilitated through the use of the systems evaluated in this study, IRS, ND, and CPOE has positive impacts on patients' outcomes, efficiency of operations, and the overall performance of the studied hospitals.

The CPOE system shows a potential to increase both patient outcomes and healthcare efficiency by facilitating smoother cancer care delivery and reducing drug prescription errors. The private/public nature of hospital did not have any visible impacts on patient outcomes and healthcare efficiency, as the core business is the same between private and public hospitals i.e. patient care.. Private hospitals seem to build upon brand and 'face value' elements to attract more patients by introducing state-of-the-art systems, the use of these system was not the first factor the patients took into consideration when making the decision on where to receive the care they need. However, the adoption of such systems attracted patients given everything else in the care delivery was the same with the studied hospitals.

On the other side, the results show that embedding IS/IT into various healthcare delivery operations in the studied hospitals has introduced a significant change to both care givers and patients. In addition, given the CPOE is internationally developed, the results from the interviews showed that it still needs some 'domestication' to better attend to the users' requirements. Similarly, the ND system was still under development during the data collection phase, which resulted in a number of technical problems and thus frustrated the nurses. No downsides were reported with the use of the IRS system.

5 Conclusion

Correctly and completely identifying the business value of IT in healthcare contexts remains a challenging task. To address this, three clinical systems were examined to better understand how information technology can facilitate the generation of business value in healthcare. The BVIT model was constructed to map the studied systems, and to understand what role private/public classification can play in the context of the two tier Australian healthcare system. All of the systems had direct and indirect impacts on generating business value. The BVIT model was found to be helpful to investigate the business value of a vast range of clinical IT systems. The next stage of research will study the CPOE system in Australian public hospitals as the systems are implemented. Given that the Australian healthcare system supports both public and private healthcare delivery models and the model in this study was shown to be as relevant in both spheres, this provides strong support for the applicability of this model in other healthcare contexts; namely UK or US where, as discussed earlier, the healthcare systems tend to be essentially public and private respectively.

In general, investigating the business value of IT in healthcare is a challenging undertaking, due to the complexity and uniqueness of the healthcare industry. Unlike other industries such as finance, retail, and manufacturing, various non-monetized aspects need to be taken into consideration with evaluating the business value of IT in healthcare.

This study has implications for both theory and practice. For theory it significantly describes the development of a systematic and rigorous framework to enable and facilitate the establishment of business value of IT in healthcare and also to value the IT solutions in healthcare irrespective of the public or private nature of healthcare system being studied. For practice it provides a systematic approach that can be applied to any healthcare context irrespective of the underlying healthcare system to facilitate a fuller and deeper identification of the actual business value of IT in a specific healthcare context.

Notes

1 For ethical and commercialisation considerations, the reference is available upon request.

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Innovation in Micro, Small and Medium Sized Enterprises: New Product Development, Business Model Innovation and Effectuation

JUKKA HEIKKILÄ & MARIKKA HEIKKILÄ

Abstract Digitalization increases the need for innovation of the business models to a new high, also in micro, small and medium sized businesses (SMEs). Every third SME is engaged in Business Model Innovation (BMI) activities, but few of them in a systematic manner.

Earlier empirical and theoretical research suggest that BMI is, and should be, an iterative process of adjustments in pursuit for better performance and success with New Product Development (NPD). NPD and BMI research streams use causal constructs with focus on external technology driven or market driven internal resource optimization. Studies on effectuation and bricolage, in turn, indicate that entrepreneurs' passion, curiosity, and originality can compensate limited resources for innovation in SMEs.

Building on these approaches, we propose a framework to analyze innovation in SMEs with case studies. The empirical data was collected in in Horizon2020 funded Envision project, where we use multiple case study approach. For this study, we select failed, surviving, and successful BMI cases to recommend effective BMI for SMEs and line out directions for future research.

Keywords: • Business Model Innovation • New Product Development • Effectuation • Bricolage • SME • Market strategy • Performance •

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1 Introduction

Digital transformation provides opportunities also for start-ups and early stage companies to innovate products and new ways of doing business. Where *New Product Development (NPD)* takes radical, technology-push disruptive change process as its starting point for new, competitive products (Christensen & Raynor, 2003), an evolutionary view about market-pull incremental effects on operations and products is provided by *Business Modelling* (McGrath, 2010). These alternative views have been under debate on innovation in corporations (e.g. Christensen et al., 2016). Moreover, studies on micro, small and medium sized organizations' (SMEs) survival provide growing evidence that entrepreneurial passion and originality can, indeed, compensate limited resources (Stenholm & Renko, 2016). This intrinsic motivation and aspiration of abstract nature, i.e. *effectuation* – is expected to help SMEs in business model innovation, BMI (Sarasvathy, 2001a,b). The effectual view supplements the above rational, causal theories of market-pull with incremental adjustments and technology push of radical, disruptive change.

But are there links between NPD, BMI, and effectuation to performance in the real-life of SMEs? For this purpose, we synthesize a framework for inquiry to find out the elements of failure, survival and performance in select case SMEs. We first discuss NPD and its connection to BMI. Then, we present effectual reasoning and bricolage, and how they are related with BMI. Third, building on the previous discussion, we compose a framework for analyzing innovation activities, strategic intent, and performance of SMEs with five selected SME cases. Finally, we discuss our findings, innovation performance of SMEs, and directions for further research to confirm our tentative results.

1.1 Lessons from innovating new products

General finding in NPD literature is that radically new products built on novel technology fail often, mature slow, and are accepted on the market gradually over time due to tardiness of diffusion and negative attitudes towards new technology (Samli & Weber, 2000). But, if such a product offers clear advantage in comparison with competing products, the success rates are improved significantly (Bishop & Magleby, 2004). New technology becomes even more attractive in the light of the findings that on unfulfilled markets novel products tend to sustain longer than products built on minor developments, or product line extensions (Samli & Weber, 2000).

Spending big (i.e., >20% of the turnover) on new product R&D works in increasing the number of new successful products (Samli & Weber, 2000). High-quality development teams consisting of dynamic, motivated, experienced and talented developers improves the odds of success further, especially if the management provides direct support, or introduces systematic methodology for NPD (Bishop & Magleby, 2004).

Furthermore, speed of NPD has become increasingly important due to continuous reduction in the product life-cycle time and increased competition due to global, technological progression. Rapid NPD, prototyping, and testing increases likelihood of success, as iterations help in discovering errors, and provide flexibility and better understanding of the product potential on the market early (Chen et al, 2010; Ries, 2011). As an indication of this, Sarja (2016) raised scalability, visibility, and timing as additional factors important to the success on digital products business landscape.

As trying to build innovations only on internal technology-push is unlikely to succeed (Samli & Weber, 2000), companies are encouraged instead to focus on their customers' needs already during the development of the product (Bishop & Magleby, 2004). This also helps to prepare unfulfilled product-markets for innovation. The same applies, if the novel technology and market analysis are used in combination during NPD-process beyond regular interviews with customers and end-users. Careful examination of alternative technologies, products, and markets during the development by product developers with end users further enhances the likelihood of success (Bishop & Magleby, 2004).

Interestingly, while the most growth potential in markets is attributed to SMEs (EC, 2014; EASME, 2015), SMEs often are limited in capabilities of the above NPD success factors (Leithold et al., 2016). Thus, creating NPD capability is the first requirement SMEs must fulfil. Noke and Hughes (2010), for instance, show, how SMEs employed strategies that combine their internal capabilities while minimising their internal weaknesses by partnering and outsourcing. Their study thus highlights that it is essential for SMEs to get involved in external NPD partner networks to kick-start the change process and to gear up for superior product-market innovating capability (Noke & Hughes, 2010).

We conclude that NPD literature separates technology-push and market-pull as drivers of innovation. Because customer involvement is to help in incremental innovation, involving customers may be detrimental to radical innovation (Scaringella et al., 2017). The reasoning is that when a firm focuses on existing customers, it may not recognize opportunities that arise in emerging markets or customers being offered disruptive solutions by innovators (Christensen, 1997). In the light of the above, it is claimed that the process driven by technology-push leads often to radical innovations, whereas market pull is more often served with incremental innovations to the user needs. However, recent research argue that the two forces are complementary and necessary in NPD (Scaringella et al., 2017; Sarja, 2016). Therefore, building successful new products on new technology is lucrative, because of the potential upside benefits – fast adoption, long lifetime, low competition. However, most of the means for successful new product launch do not depend on the technical skills only, but on the capabilities of the product development teams, systematic management support, ample resources combined with the knowledge and skilled, iterative probing, realization, and shaping of the market, technology and needs.

1.2 Business Model Innovation Effectiveness

Business model innovation means notable changes in the logic how an organization creates, delivers, and captures value. Foss and Saebi (2017) sum ‘mainstream’ BMI outcomes and research directions by analyzing 150 peer-reviewed scholarly articles on BMI published between 2000 and 2015. Their analysis reveal external (e.g., technology, regulatory, stakeholder needs) and internal (e.g., strategy, capabilities) antecedents that drive the BMI (scope, novelty) with expected outcomes (financial performance, innovativeness, cost reduction). This process is moderated by macro-, firm-, or micro-level variables, and emergers as cognitive structures (Foss & Saebi, 2017)¹. The structures can either respond to exogenous technological and regulatory changes (e.g., Zott and Amit, 2008; Teece, 2010), or operate as a learning process of iterative analysis and experimentation in response to changes in the environment (e.g., Chesbrough, 2010; McGrath, 2010; De Reuver et al., 2017). We see these as fine tuning the previous view on the NPD incremental adjustment of internal resources.

Yet, as evidence suggests, new business models have often been the source, and not the outcome, of industry change (Markides, 2008; Christensen et al., 2016). Companies on ‘traditional’ industries have been able to generate supernormal profits by designing new business models in the presence of major technological progress, or in the absence of regulatory limitations. These new business models have boosted large-scale disruptive industry change reaching far beyond reacting to changes in business environment, or developing new products. It is about being active in innovating and implementing radically new ways of doing business by the management.

BMI drivers of SMEs mostly differ from those of previously mentioned industry-changes – a typical high-tech start-up or growth venture builds its future on one product to the global market (Sarja, 2016). Furthermore, we do not know too well what facilitates BMI in entrepreneurial firms, and how are these drivers and obstacles different from incumbents (Foss & Saebi, 2017). A recent empirical study (Bouwman et al., 2016) reports that 37% of SMEs in Europe are involved in BM Innovation, but only 15% of them are familiar with mainstream BM methods like CANVAS, STOF, Visor, or BM Cube. Diverse tools are used, but their use is limited in scope and sophistication, compared to method-based BM-toolsets. More than 50% of the SMEs use consultants for BMI, which may explain the unexpectedly high penetration of BM among the studied SMEs.

To conclude, despite the lack of sophistication, BMI is about to become mainstream in SMEs, leveraging their BMI capabilities and capacity. But does our contemporary BMI research capture the unique features of SMEs?

1.3 Effectuation, bricolage and entrepreneurial survival

Whereas BMI and NPD literature is mostly focused on causal approaches on developing business towards given goal, the entrepreneurial literature emphasizes the effectual side of businesses, which is considered as the inverse of causal. Causal rationality starts with a pre-determined goal and a given set of means, and seeks to identify the optimal, such as fastest, cheapest, or most efficient alternative to achieve the given goal. The effectuation process is highly subjective, starting from the capabilities and resources of the entrepreneur, and takes this “*set of means as given and focus on selecting between possible effects that can be created with that set of means*”. (Figure 1, Sarasvathy, 2001a)

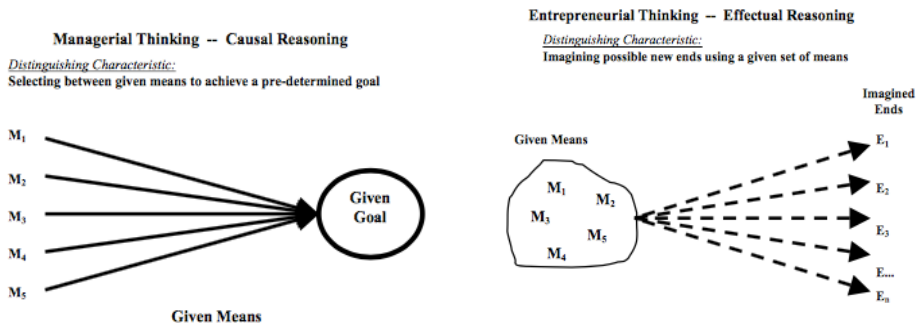


Figure 1: Causal and effectual reasoning (Sarasvathy, 2001a).

Sarasvathy (2001b, p. 252) proposes four aspects that differentiate causal and effectual reasoning. She builds on her conceptual study, and on her empirical enquiry on serial entrepreneurs:

Effectuation Entrepreneurs have been shown to have high tolerance for ambiguity. Whereas causation models aim to maximise the potential returns by selecting optimal strategies, the effectuation predetermines how much loss is affordable and focuses on experimenting with as many strategies as possible with the given limited means (Sarasvathy, 2001b).

Causation models, such as Porter (1980), emphasise detailed competitive analyses. Effectuation emphasises strategic alliances and pre-commitments from stakeholders as way to reduce uncertainty and to create barriers of entry (Sarasvathy, 2001b). Present business modelling requires extensive partnering from the very beginning for developing new products and viable services.

Causation models are appropriate, when, e.g., knowledge or expertise of a specific new technology pre-exists. Effectuation is better for exploiting contingencies that arise unexpectedly over time (Sarasvathy, 2001b). This is where also recent BMI studies have paid attention to (Bouwman et al., 2017).

Causal reasoning focuses on predictable aspects of an uncertain future. According to Sarasvathy, effectuation, in turn, focuses on the controllable

aspects of an unpredictable future. For example, causation model, such as Kotler (1991), defines a market – assumed to exist independent of the entrepreneur - as the universe of all possible customers. An effectuating entrepreneur would define her market as a community of people willing and able to commit enough resources and talent to sustain her enterprise's survival, and creates the market by bringing together enough stakeholders, who buy into her idea (sometimes called as FFF, Family, Friends & Fools). BMI researchers have identified the tendency of entrepreneurs to seek familiarity in business models (Chesbrough & Rosenbloom, 2002), and the challenges they face when confronted with unfamiliar concepts.

Later research show that effectuation may play a role in search of BMI effectiveness: e.g. Sosna et al. (2010) suggest that initial BM design takes form on the owner-manager's cognition and sense-making and in the early phases of NPD and BMI processes may be characterized by effectuation behavior.

Effectuation is closely related with *bricolage* (Fisher, 2012). The term was coined by Weick (1993) in organizational studies, later adopted Baker and Nelson, (2005), and Ciborra (1996) in Information Systems field. Bricolage means good understanding of the resources at hand; innovative, 'good enough' use of combinations of resources at hand to problems, or, opportunities; and active self-correcting trial-and-error "make do" - behaviour. For example, Stenholm and Renko (2016) suggest that the entrepreneurs passionate about developing their firms and inventing new solutions are more likely to engage in bricolage. This involves "*creative manipulation of 'existing' or 'available' resources, such as materials and financial resources, to solve a problem at hand or to create new opportunities*" (Stenholm & Renko, 2016). Furthermore, bricolage is a form of effectual reasoning of an entrepreneur to avoid the hazards embedded in the critical early stages of a new firm (Stenholm & Renko, 2016). They conclude that "*passion for inventing and developing enhances entrepreneurs' "make do" behavior and, consequently, indirectly increases the chances for entrepreneurial survival*". This is an addition to more rationalistic success factors by NPD and BMI literature. However, there is mixed evidence on the effectiveness of bricolage. For example, in Ciborra's early (1996) study on a multinational high-tech company, bricolage helped it to adapt, but simultaneously constrained its effectiveness.

To summarize, many of the earlier justified criticism towards business planning (e.g. Sarasvathy, 2001b), business modelling, and BMI has been alleviated in recent BMI techniques. Sarasvathy's original effectuating entrepreneur resembles recent lean startup ideologies (Ries, 2011). Their main argument is that it is rational to bricolage and iterate, because it eventually leads - through an unpredictable groping process - to rational goal (like in satisficing behavior under uncertainty). Lean startup emphasizes also effective and measurable outcomes, like BMI does (Heikkilä et al., 2015). Therefore, effectuation and bricolage should be explicitly embedded in innovation effectiveness evaluation at SMEs.

1.4 Synthesis of above research streams

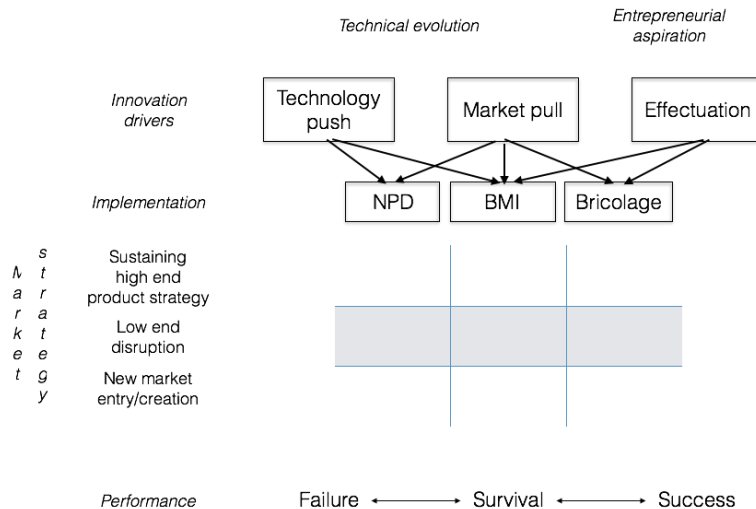


Figure 2: Synthesized framework

Figure 2. summarizes the concepts of this paper, and spans the framework of inquiry. It links three potential drivers (technology push, market pull, and effectuation) with three methods for innovating (NPD, BMI, bricolage). These are in turn accompanied with three market strategies (sustaining, low end entry, and new market creation (Christensen, 2009)). Eventually, the decisions and steps taken are expected to influence performance, which can range from failure to survival and success.

Innovation drivers:

Technology push: Technical evolution triggers, or enables new ways of doing business as much as it does create new products. Often the starting point is basic scientific research, or applied research and development in organisations. These proceed through design and development into a product that can be manufactured effectively and economically and then sold on the market. Radical breakthroughs are more likely to be achieved through technology push.

Market Pull refers to the need for a new product or a solution to a problem, which comes from the market. These needs might be perceived by an entrepreneur, for instance through market research, which assesses what needs exist, how far they are met by existing products and how the needs might be met more effectively by means of a new or improved innovation. Market pull more often leads to incremental innovations.

Effectuation: highly subjective approach, where innovation starts from the capabilities and resources of the entrepreneur. The entrepreneur selects between

possible services/products that she can create with the set of means available to her.

Implementation

NPD: Product idea passes through a series of stages from ideation through design, manufacturing and market introduction. Recent research suggests that technology push and market pull are complementary and necessary for NPD (Scaringella et al., 2017; Sarja, 2016).

BMI: Organization, finance, customer, service and technology are main components of the BM. Change in one or several of these may result in business model innovation.

Bricolage: utilising the combinations of resources at hand to act on problems, or, opportunities. Self-correcting trial-and-error “make do” -behaviour.

Market Strategy

High-end strategy: incremental improvements to the current products on markets

Low-end strategy: provide a simple or low price solution offering good value for money.

New Markets: Serve customers, who were not previously served by existing incumbents.

Performance

Failure: the business/innovation fails. For instance, the product is redrawn from the markets, or business is in solvency, or bankrupt.

Survive: the business/entrepreneur is hanging on, or at high burn rate; avoiding failure, but not profitable.

Success: the business is clearly profitable

2 Research Methodology and case selection

We use multiple case study approach to analyse BMI effectiveness in five SMEs (Table 1). Multiple cases serve as repetitions, extensions and contrasts to the emerging theory, and the researcher develops an understanding of why certain conditions did or did not occur, and then offers interpretations (Yin, 1984). Data was collected by the authors of this paper and the other consortium partners in a multi-national EU-funded project. The research collection follows a case study protocol, which forms the basis for data gathering and case data repository. This makes the data well-(Sarasvathy, 2001b) structured and suitable for cross case analysis. The protocol is available on request from the authors.

Table 1: Cases

	Company Size	OUTCOME
Atelier	Micro	Failure
Everyone deserves plants	Small	Survive
Fresh Natural Air	Medium	Survive
Event Management Service	Small	Success
Electronic medicine dispenser	Medium	Success

Using subjective sampling, we selected five SME cases with different performance outcomes (failure, survival, success). Under these outcomes, we can first detect whether the drivers, implementation approaches, or market strategies are different for outcomes (they should) and then pursue explanations to the differing outcomes with the synthesized framework (see Figure 2). The cases are listed in Table 1. In the Appendix, we describe and analyze the cases in more detail.

3 Analysis

Atelier

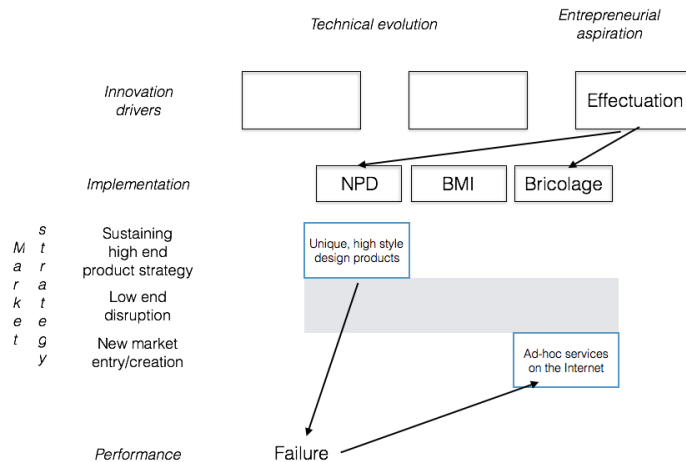


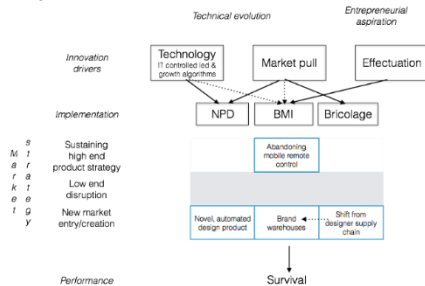
Figure 3: Failure: Atelier (case a)

Atelier (case a, figure 3) started as self-employed artist 12 years ago. The entrepreneur was devoted to creating handicraft products (NPD) by combining raw materials in novel ways. Despite the innovative products, the production does not scale up, visibility is hard to get, and timing depends on fashion rather than on Atelier’s action. The atelier had a store where she sells her products to tourists (mainly in summer), or locals looking for a birthday gift etc. She also imitated the competitors by being present in Facebook and in online store. In 2015 she switched from a self-employed person to an independent entrepreneur. Then she could hire a person to run the store and administrative matters.

Unfortunately, the sales could not to cover increasing costs. The business was closed one year after she became an entrepreneur with company status and consequent legal obligations. But, already the same year she started experimenting with a new business idea related to remote life style coaching which she marketed in her Facebook. The case is typical case driven by effectuated entrepreneur and bricolage.

Everyone Deserves Plants (case b, figure 4) is an SME initially established by a designer, who had the vision to create a beautiful consumer product for cultivation of herbs in-house. With partner network – such as researchers specialized in greenhouse cultivation - the micro-sized start-up company developed, and recently patented world-wide its unique IT-controlled led light and growth system. In parallel with NPD, they started using BMI tools to design and revise their business model and value proposition (they imitate the BM of Nespresso with alterations), analyze the potential markets, and to create user profiles (i.e., ‘personas’). This way they dared to abandon a fancy and fashionable mobile app for the users, but their analyses proved that there were no markets for remote control feature. The product is competing with other high-end consumer products, because there have not been direct competing products. To increase its sales, the company refocused its sales channel strategy from design shops to high-end malls and warehouses. In four years of operation the size of the company has been growing from four to 13 people. Thanks to its awarded and patented product the SME is attractive to the investors to raise capital, but it has not been able to reach the planned turnover targets and is making loss. Scaling up the production is possible, but the market is still emerging – it seems the visibility of the product and timing of market entry are not optimal.

Everyone Deserves Plants



Fresh Natural Air

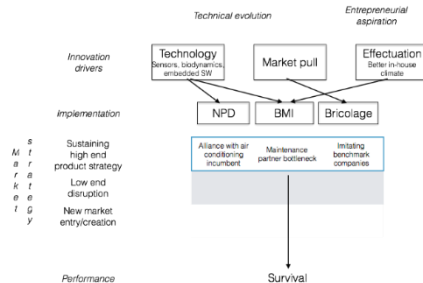


Figure 4: Survivals: Everyone Deserves Plants (case b) and Fresh Natural Air (case c)

Case c (figure 4), Fresh Natural Air, started from the idea of the founder, who suffered from poor in-door air quality. He wanted to improve the air quality by bringing part of nature inside, i.e. living plants. He started to build a green wall with a fellow university student, who had both practical and theoretical knowledge on purifying water with ecological means. The first prototypes were put together of plastic and vent duct tape. Simultaneously, they were designing business models using BM canvases. The challenge was to make the product look good and the plants flourish. So, they developed a remote sensing system with embedded sensors to measure the status of the green wall and its

environment. This data is analyzed automatically in a cloud software. The adjustments to the plants growth parameters are fed back to the green wall at customer’s premises. Yet, the system needs regular manual maintenance (watering etc.). Imitating benchmark companies from other industry sectors, the SME decided to bundle all – green wall, remote control and maintenance – into one service, which it leases to b-to-b customers. Right timing is hard, despite the good visibility, because the maintenance does not scale up well. Initially the target was new market entry, but later they refocused on clean tech markets, and have an alliance with a large air conditioning incumbent firm, which could help in securing maintenance services in selected cities. The personnel of the company has increased from 3 to 60 in five years. It is making loss, but has doubled its turnover for the last two years. Thanks to its iterative BMI and NPD, (it’s been awarded, too), the SME is seen attractive by the investors.

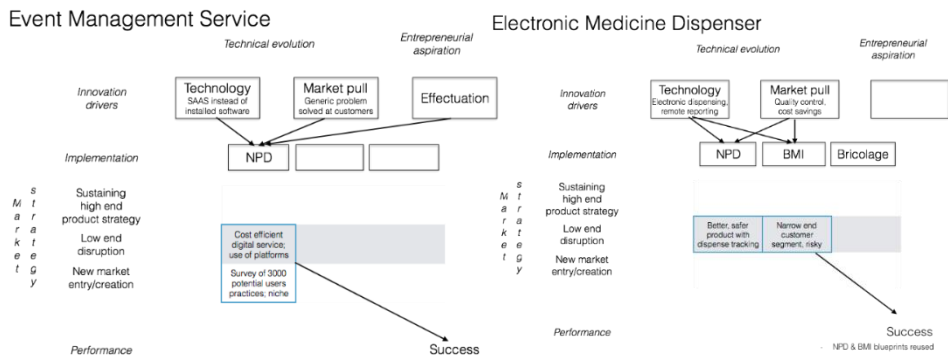


Figure 5: Successes, Event management service (Case d) and Electronic Medicine Dispenser (Case e)

Event Management Service, case d (figure 5), was established in 2007 by two co-founders. They worked in hotel and travel business, and found managing events a constant struggle with reservations, cancellations, detailed HoReCa²- arrangements, etc. They were looking to find a service or product to help in this task, but to their surprise they could not find neither affordable services, nor suitable products (software), so they started developing one for themselves, in true NPD sense. In parallel, they made a market survey that confirmed the existence of a niche market for automating of the event arrangement and management in businesses and public organizations. The initial in-house, back-office version was further developed to a web-based SaaS service for event management. The market survey made them also known to the potential customers, and their revised product got a flying start from the beginning. The aim was to provide affordable service to cut costs of arranging events on the current market, but they could also reach new customers that were not served by the existing incumbents. Nowadays, the awarded service is available worldwide, and runs constantly through NPD iterations, which ensures compatibility with customers’ information systems. Their initial timing was good, product gained good visibility through the market survey. The current implementation of the platform scales up well. Case d has grown during the last four

years from 12 to 21 persons. Through these years, it has been profitable for several years showing steady turnover growth and even better growth in net income.

Electronic Medicine Dispenser, case e (Figure 5), established in 2003, is a high-tech company with technology-push approach. Its innovative new dispenser service was expected to have pull from the market: in addition to its main value proposition of providing improved dispensation safety and quality of medication to the patients, it could promise cost savings to the hospitals and nursing homes. The company is experienced in NPD, but in this case, they used also BMI tools (BM canvas and ecosystem analysis) to support the process. Business modelling revealed that the envisioned product was not lucrative enough for one of the key partners in terms of business. Therefore, case e decided to discontinue the development, and instead, focus its NPD & BMI efforts onto more potentially profitable and feasible products. Even though the dispenser service failed first, company's partners eventually implemented a derivative design and brought it to market with SME's major incumbent partner, which is a visible actor with a credible reputation on the market. SME is employing around 120 persons and runs profit. Their present implementation of the service scales up well, and was synchronized on time with the incumbents' product launch to gain momentum. To us, case e appeared least driven by effectuation, but rather relying on NPD combined with customer and partner network based BMI.

4 Findings and Conclusions

Researchers have observed that business model schemas are complex structural representations of the underlying activity systems. As such, they are also difficult to ideate from scratch due to the challenges of working out at once all the attributes and interrelationships comprising a complex system (Baden-Fuller and Morgan, 2010; McGrath, 2010). This means that ideation anchors to a known way of developing new products, elements of a business model, or available resources (bricolage), when met by changing circumstances. This all is expected to depend on entrepreneurial effectuation. Therefore, we expanded the concept of BMI with elements of NPD, effectuation and bricolage of entrepreneurs. Our framework also can depict the market strategies with profitability and sustainability.

We used the framework to analyze five case SMEs. Most of the case companies are awarded thanks to their innovative product/service and/or business models, too. The case companies were established around 10-15 years ago. One of them filed in bankruptcy, two are surviving along investors' funding rounds, and two companies are going strong.

Most profitable business model has a scalable product (case d) that meets directly a customer need outside the customers' core business. BMI plays a minor role, because the business has hit a 'sunspot' from the beginning, and is able to keep that position due to constant product updates in close development co-operation with their customer.

The other successful case (case e) innovated an idea, which could scale-up by co-operating with its partners. However, they could not convince all partners (not all parties are entrepreneurs, but rather risk averse bureaucracies) to commit to the service at the first place, even though the market was there. The launch did not appear profitable according to business modelling. BMI helped the company, first, to put the market entry on halt, and then, to reconfigure the fundamental idea with more powerful partners and reschedule the launch. Fast business modelling iteration seemed to be a key to successful adjustment to the market needs, improving visibility, and timing in addition to its originally good scalability.

Survival cases' (cases b and c) business models both have a physical, fancy product with extended, IT-based features and lucrative stories, but their business models need constant revisions due to the bottlenecks in expanding to new markets with logistic, linguistic, and product related complications. Fast iteration is a necessity, but contracting, sub-contracting and building the physical operations on various markets takes a time and a lot of entrepreneurial effectuation, but the problems with scalability and timing persist.

Finally, the failure (case a) had high-end sustaining product strategy, improving the quality of the existing product and service by formalizing business. However, the SME did not survive on the market with that approach, because it was accruing extra costs, and losing entrepreneurial agility.

All the cases follow different paths of evolution and market strategies, and in all survivor cases the take-off has taken years, even with the most successful of the selected case. It hit a bulls-eye niche with NPD, thanks to its effective indirect pre-marketing for the clientele, and has been able to maintain that position by iteratively co-creating integrated new features without losing its core product simplicity. The need for BMI is marginal. It is a textbook example of successful NPD.

The companies that could create a viable business model can implement product and BMI very differently. It seems that innovative physical, high-tech products take a long time to develop to a mature profitable business even though entrepreneurs know and iterate their business model regularly (cases b & c). On the other hand, the most profitable of the pack, case d, has a business that is virtual by nature, builds on platforms, and scales up to thousands of users by self-service and has high demand in a niche market. It shares some similarities with case e, which used to develop a portfolio of new products at constant rate, but later to direct their development efforts according to BM analyses towards most potential business prospects. Their business modelling thus articulated the product and business roadmaps in a way that they could be put aside for a while and ramped-up in short notice, as the opportunity emerged.

The cases show how effectuation has a strong influence in the initial stages of the innovation. Typically, the idea for the business came from the life or work experiences of the founder(s). What is remarkable in most surviving cases is that the

companies/entrepreneurs learned to broaden their business thinking with BMI. The initial mindset is product-centric, many times with altruistic mind-set of improving the lives of the people, or their environment. Typically, after the rounds of BMI they can improve timing and visibility of their products better to the needs of the markets. However, the problem of scalability with physical products remain.

Finally, In SME context, the value of BMI is in iteration and as the means to identify and react upon exogenous changes. The idea of combining NPD, BMI and entrepreneurial effectuation by bricolage seems to reflect the reality in the case companies mostly well. It is also worth noting that BMI improves the entrepreneurs' product and business development skills, and helps to time innovations entry to the market.

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Notes

1 Doz and Kosonen argue that "...business models stand as cognitive structures providing a theory of how to set boundaries to the firm, of how to create value, and how to organise its internal structure and governance.", (2010, p. 371).

2 Hotels, Restaurants, Catering

Appendix

Cases

	Case A: Atelier	Case E: Electronic medicine dispenser	Case B: Everyone deserves plants	Case C: Fresh Natural Air	Case D: Event Management Service
Drivers	<p>Effectuation. The entrepreneur wants to create new and improved products following her artistic visions.</p>	<p>Technology push: Electronic dispensing device and remote monitoring of medicine use.</p> <p>Market Pull: Cost saving through reduced need of patient visits, improved safety and quality.</p>	<p>Technology push: IT controlled lightning & growth system (patented).</p> <p>Market pull: There was not (yet) markets for product that consumer could use via mobile phone.</p> <p>Effectuation: A designer wanted to design a product</p>	<p>Technology push: Sensors, biodynamics, embedded SW (patented).</p> <p>Market pull: Clean-tech forerunner related with high growth potential.</p> <p>Effectuation: The product idea came from the CEO who suffered from poor indoor air quality.</p>	<p>Technology push: SaaS instead of installed software.</p> <p>Market pull: Lack of services was recognized, market creation by survey.</p> <p>Effectuation: The founder had 10 years of expertise from the field with</p>

J. Heikkilä & M. Heikkilä: Innovation in Micro, Small and Medium Sized Enterprises: New Product Development, Business Model Innovation and Effectuation

			for cultivating herbs in-house.		an emerging vision.
Implementation method	<p>NDP: The entrepreneur was devoted to creating and implementing new products.</p> <p>Bricolage: She was combining the raw materials in new ways to create new products by herself.</p>	<p>NDP: the company was accustomed to creating high-tech products.</p> <p>BMI: BM and ecosystem analysis revealed that the BM is not viable for one of the main partners.</p>	<p>NDP: the product was designed by the founder.</p> <p>BMI: BM canvas and later Value proposition canvas was used.</p> <p>Bricolage: for expanding to international markets, they select the target cities/countries by hunch, but want its viability affirmed by BM analysis before entry.</p>	<p>NDP: The entrepreneurs created prototypes and minimum viable products to test the product with users.</p> <p>BMI: simultaneous development of product and BM with canvas.</p> <p>Bricolage: The first prototypes were created of duct tape and some plastic boxes.</p>	<p>NDP: The founders created the product first for internal use, then offered it to markets.</p> <p>BMI: market analysis showed the lack of products on the market.</p>
Market strategy	<p>High end: High-quality, unique products.</p>	<p>Low end: The aim was to use high-tech to provide cost saving and affordable service for current market.</p>	<p>New market: Novel, automated design product that was initially to be distributed via design shops, later switched to brand warehouses.</p>	<p>High end: High-quality service, requiring both remote and on-site maintenance, cooperation with major air conditioning incumbent.</p>	<p>Low end: The aim was to use latest technology for lowering costs of the activities in the clientele.</p> <p>New market: Reaching new customers by market survey with affordable costs.</p>
Performance	<p>Failure. The business was closed. Soon she was experimenting with a new business idea of life style coaching.</p>	<p>Failing first, then success. The business development was discontinued, the SME put its effort in other business ideas, but ramping up at opportunity. The SME is profitable.</p>	<p>Survive. The company has not been able to reach the planned turnover targets and is making loss. The size of the company has increased from 4 (2013) to 13 (2015). SME is attractive to the investors.</p>	<p>Survive. The company is making loss, but has doubled its turnover for the last two years. The size of the company has increased from 3 (2012) to 60 (2017). Product story is lucrative to investors.</p>	<p>Success: The SME has been very profitable for several years. The size of the company has increased from 12 (2012) to 21 (2015).</p>

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The Playful Learning Approach for Learning How to Program: A Structured Lesson Plan

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Abstract IT-based learning has proven to be a useful approach to educate people regardless of their age or other characteristics. However, the developments in IT and its socio-economic implications have a high influence on education with new approaches and methods, such as the playful learning approach (PLA). This approach has been widely researched and can be applied to teach programming as one of the core digital skills. However, scientifically developed and validated structures for PLA units in programming are rare. In this paper, we offer a lesson structure for a PLA to programming by addressing the five core success factors of playful learning. Our structure includes six units and follows an iterative and agile procedure by combining game features with the educational content. Educators and teachers can use the presented results to design the lesson structure in their classes. Furthermore it offers a basis for further research in the area of PLA and can be used as a starting point for the development of educational games and concepts in teaching how to program.

Keywords: • IT-based learning • programming • playful approach • best practice • lesson structure •

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1 Introduction

The term *Educational Technology* is defined as "the study and ethical practice of facilitating learning and improving performance by creating, using, and managing appropriate technological processes and resources" (Robinson, Molenda, & Rezabek, 2008). E-learning, web-based learning, online learning, and IT-based learning are just a few examples for technological processes and resources based on Information Technology (IT). However, IT is a constantly evolving sector influencing many areas of all our lives. Thus, education is changing since IT allows for many new possibilities; especially in combination with the playful approach to learning. Playful learning, often also called *edutainment*, is a recent trend in academic education which focuses on the *hands-on* practice of learning instead of on the *sit-and-listen* approach, spanning between free play (in which the students play independently), and guided play (where an overseer directs their play)(Lillard, 2013).

In the digital economy, there is a huge demand for skilled IT workers, not only in the IT departments but across entire organizations (Capgemini Consulting, 2013; Prifti, Knigge, Kienegger, & Krcmar, 2017). This demand can be satisfied by a broad introduction of students to the digital world and further education in IT skills early on. Additionally, in today's society, it has become a standard for students to have constant access to the internet and the immediate on-the-spot knowledge provision opportunities that are provided by it. Students use digital means to learn, communicate, access knowledge, and for other professional application (Baggia et al., 2016). A case study involving undergraduate students in Slovenia, stated that 37,5% of the students reported to use the web frequently in more than half of their courses, and 50% even stated that they always use web resources (Kljajić Borštnar, 2012). This trend in students' behaviour can be observed growing rapidly. In 2002, a case study, involving 2054 students at 27 institutions of higher education across the United States, stated that 73% of respondents claimed to use the internet more than the library, while only 9% said they use the library more than the internet for information searching (Jones, 2002). Thus, our nowadays educational systems are facing both, students with highly developed digital skills and the necessity to evolve the digital skills of students in order to support self-regulated personalized learning (cf. Zimmerman, 2002).

IT-based learning approaches gain momentum in our digital economy as countless numbers of software projects, for computers as well as for smartphones, are realized with the goal to educate students on different topics. The importance of digital mediums as a form of education is increasing (Blamire, 2010), and many academic researchers, such as McGonigal (2011), Prensky (2005), Gee (2003), Fabricatore (2000), and Pivec and Moretti (2008), put increasing effort into the exploration and validation of teaching techniques using the playful approach as a core concept. Many of these playful approaches use hands-on and self-regulated or personalized learning as a medium to transfer knowledge to students and the usage of the self-regulatory processes has shown strong correlations with high academic achievement (Everson, n.d.)

Case studies implementing the playful learning approach (PLA) in all kinds of fields of education are widespread, although the majority of them supplies no scientific results concerning a structure on how to implement such a playful teaching model. Thus, this paper aims to fill this gap and hence to answer the following research question:

What would be a best practice for programming lessons by using a playful approach?

Fullan (2007) asserted that the moral purpose of education is to equip students with the skills that enable them to be productive citizens when they finish their studies. Thus, in the age of the digital economy improving the digital skills should be one of the topics students ought to learn in school. Trilling and Fadel (2009) called education in information, media, and technology skills vital for the 21st century job market, differentiating between the traditional education subjects and upcoming subjects such as information transformation and coding skills which are much needed in today's economy.

As the structure of a teaching approach is always to some level dependent on the subject and because of the dire state of the computer science education throughout Europe, we focus on the area of computer science, with the special topic of learning how to program, as a framework in which the structure is developed. However, the structure is easily transferrable to other school subjects as the core composition stays the same.

Next to the success factors identified for teaching with a playful approach in Heininger, Prifti, Seifert, Utesch, and Krcmar (2017), other factors also need to be taken into account concerning a successful implementation of a study course. Examples are the relevant curriculum (in our case technology and computer science), and specific environment factors of the respective school or university (the weekly hours planned for computer science, the duration of the course, and the chosen programming language). The development of the structure will manipulate certain environmental factors as well as provide opportunities for the students to become motivated, interact in class, and engage with the content of the curriculum on a deeper level than in a "traditional" course in which the lecturer just transfers knowledge by lecturing.

The overall goal is to promote continuous passion and motivation to look beyond the box and to become interested in programming. The ideal outcome would manifest in students wanting to code even if there is no extrinsic reason to, such as good grades in school or any other rewards from the outside. The development of the curricular structure and the structure of implementation targets this endeavor.

2 State of the Art

Driven by rapidly advancing information technology, many academic researchers have lately delved into the topic of different approaches to education. The benefits and theoretical as well as practical outcomes of playful approaches in education have been

put to test in many settings, e.g. in undergraduate and postgraduate programs (Connolly, Stansfield, & McLellan, 2006), at high school (Papastergiou, 2009), universities (Colace et al., 2008; Iglesias & Gálvez, 2008; Jantke & Woelfert, 2012), and even at an US Air Force Academy (Fagin, Merkle, & Eggers, 2001). However, scientifically developed and afterwards validated structures for implementation are rare and often not documented. Only Simionescu and Marian (2016) present a proposal for a change of paradigm, based on a playful approach in course structures for efficient student evaluation.

In a previous research paper (Heininger et al., 2017) the success factors concerning the playful teaching approach were discussed and evaluated by conducting a literature review of the current state of the art. With this contribution, we aim at answering our research question, by using these success factors as the theoretic part of the basis for our structure. Table 1 shows the five key success factors influencing the outcome of such an endeavor: motivation, integration and involvement in class, the audience-centred focus, giving feedback and enhancing interaction, and the fluent integration of the educational content into the gameplay (Heininger et al., 2017).

Table 1: Success factors for teaching with a playful approach, based on Heininger et al. (2017)

<i>Success factor</i>	<i>Description</i>
Motivation	The basic reason why people do anything; The variation of individual differences; The attitude, behaviour and study practices
Integration and involvement	Self-involvement and active participation by students; The shift from the passive recipient to an active integrated partner
Adaption to the audience	Specification of the target audience; The adaption to the curriculum and environment; The game shall be easy to understand and to play
Interaction and feedback	Formal as well as informal; The individual response to the student's difficulties; The examination of different ideas and multiple perspectives
Integration of educational content into gameplay	Finding an application of the curriculum inside of a gameplay; The balance of gameplay and educational content in a game

3 Method

Curriculum decision making is generally an iterative and lengthy process, carried out by a broad range of participants and influenced by a wide variety of stakeholders (Van den Akker, 2007). Cho (1998) noted on the same subject that the implementation of curricula is not an event, but a longer change process. Following Biggs and Tang (2007), there are

three levels of learning outcomes at major institutions – at the institutional level, at the degree programme level, and at the course level. As we concentrate on the curriculum of a school, our focus is on the course level learning outcome, while the degree programme level is less distinctive. Furthermore, we limit the computer science curriculum to the subject of learning how to program in order to be able to provide a clear and comprehensive structure.

Van den Akker and Voogt (1994) noted that the curriculum should offer materials, which provide concrete and illustrative elaborations of the general program, as well as a framework for broad categories. Biggs and Tang (2007) further remarked the importance and analysed the ‘intended learning outcome’ for the student as it defines the goals of the curriculum. Based on this outcome-based learning concept by Biggs and Tang (2007) we will describe the current state of computer science curricula and point out some major design decisions for our curriculum in this chapter.

3.1 Linking to a School Curriculum

Many countries have adjusted their curriculum in the last years, adapting to the changes of the digital economy, which requires new skills (Capgemini Consulting, 2013; Prifti et al., 2017). However, specific curricula are often set at state or city level, not at national level. An example outside of Europe is New York City where a computer science course will be a graduation requirement by 2018 (Taylor & Miller, 2015). In Europe, many countries have begun to adjust their curricula as well, but major changes are still awaited by both, the industry and the academia. Austria for example requires a mandatory course devoted solely to computer science only in grade 9, teaching students about software, hardware, operating systems, and data privacy (Guerra, Kuhnt, & Blöchliger, 2012). Slovenia offers a mandatory computer science course in grade 10 (high school and gymnasium), while offering elective courses in the grades 7-9 and 11-13, teaching students about processing data, computer networks, and programming as well as algorithmic thinking and problem solving (Guerra et al., 2012). However, in 2016, Mori and Lokar (2016) criticized the outdated Slovenian computer science curriculum, dating back to 1998 with minor updates in 2008 as well as the short duration of the mandatory course of only one year. In Germany, the education system is mainly the responsibility of the federal states. In 2012 only two out of sixteen German federal states had mandatory computer science courses – Free State of Saxony in grades 7 and 8; and Free State of Bavaria in the grades 6 to 12, including topics such as introduction to software and hardware, terminology, basic concepts of information technology, computer networks, algorithms, and data modelling (Guerra et al., 2012). However, the curricula for the different types of schools in Germany, respective in each individual state, are often vastly different and some of them do not teach about computer science at all (Deutscher Bildungsserver, 2017). In 2015 a survey with 1002 German parents stated that the majority (56%) considered the children’s preparation by the schools for the digital job market ‘bad’, 5% even considered it ‘very bad’, while only 32% considered it ‘good’ and 3% considered it ‘very good’ (Netzwerk Digitale Bildung, 2015). Overall, the changes in

the education systems of European countries seem to be far behind the demands of the digital industry. It is hence our goal to develop a structure that gives incentive for students to learn about computer science (in our specific case: how to program) and changes the approach from the traditional path to a playful one.

The structure, developed in this contribution, is based on the Bavarian curriculum for vocational schools in introductory computer science courses, which divides the topic of learning how to program into three parts:

basics of modern programming languages,
programming techniques and data structures, and
object-oriented-programming.

The basics of modern programming languages include the types of data, arithmetic and logical operators, and output of data. School students learn about basic programming structures such as sequences, single-branching, and multi-branching. Furthermore, this includes how identifiers are structured, type conversion, and how statements are coded by differentiating between logical lines. Advanced programming techniques and data structures are supposed to give the students the ability to create software that is more advanced.

"Students create programming-oriented diagrams and use repetition commands and subroutines. They know the necessity of further programming techniques and structures to solve complex problems using varying data structures. Thereby they recognize how to write more effective and clearly arranged software."

(Bayerisches Staatsministerium für Unterricht und Kultus, 2006)

The emphasis lies on students learning to independently break a problem down into smaller parts and create advanced pieces of software. The modulation of problems is explained with the use of procedures, functions, giving parameters, and multiple usage of blocks of code. Knowledge about array data structures as well as objects of pre-defined classes are part of the curriculum as well. The overall goal is to teach students about complex structures like loops and functions to give them the ability to differentiate between the use of procedural structures and functions. Object oriented programming is the last part of the computer science curriculum of the vocational schools in Bavaria.

“Students ought to gain insight to how coding and handling objects work. Their ability to generate a solution creating functions based on problem is in focus.”

(Bayerisches Staatsministerium für Unterricht und Kultus, 2006)

The curriculum for object-oriented programming contains knowledge about classes and objects, their attributes and methods, as well as class instantiation. The focus lies on the

definition of classes and calling functions and attributes of the instances, as well as handling the transfer of parameters. This includes calling functionality in other functions as well as setting optional return values. The goal is to teach students about well and systematically designed structures of classes and functionality to ensure their ability to solve complex problems and give them the tools to code on their own in the future.

At this point of our contribution, we deem it important to note that the curriculum of vocational schools in Bavaria will be changed in the near future – computer science will soon not be a mandatory subject anymore at all, but rather a voluntary subject in grade 12 and 13 (Staatsinstitut für Schulqualität und Bildungsforschung München, 2017). The content of the voluntary subject will also consist of multiple optional topics from which only a few can be taught as the course will probably not have the required length in order to cover all of them thoroughly.

3.2 Choosing the Programming Language Python

The focus of an introduction to programming in secondary schools lies on giving insights into writing software and understanding the basics of programming. The usage of languages developed for children (e.g. Scratch or Snap!), which are based on graphical drag-and-drop handling, seems to be missing the point in this endeavor.

Choosing a programming language for beginners, means not only considering technical aspects, for instance run time efficiency, memory consumption, and reliability (Prechelt, 2000), but must be evaluated even more concerning the difficulty of learning the language without prior coding experience. Furthermore, there is the possibility of teaching an industry relevant language like Java, Python, and C++, or a language specifically designed to introduce programming to beginners. In a case study Ivanović, Budimac, Radovanović, and Savić (2015) note that the choice of programming language does indeed not affect the success of students in the course. They also note that "the main goal of the introductory programming course is to teach students essential programming concepts in order to develop their ability to think and solve problems by algorithms, and to acquire new/other programming languages and techniques efficiently" (Ivanović et al., 2015). This allows students to change to other, differently structured programming languages later on, if desired.

The language should have a simple syntax, provide easy I/O handling as well as output formatting, use meaningful keywords, and give immediate feedback (Grandell, Peltomäki, Back, & Salakoski, 2006). Python offers many advantages concerning grammar and writing of code: Time wasting matters of style are avoided and indentation not only structures the code grammatically but also visually helps beginners to easily understand which block of code belongs to which functionality. Another advantage of Python is its compactness and that unfamiliar code in Python is usually easy to read.

Choosing Python as a programming language affects the curriculum concerning the time, which must be allocated for specific concepts within the language. As an example,

compared to other languages, writing and structuring Python code happens mainly based on indents, which needs less time to explain to the students than the introduction of keywords like ‘static’ or ‘void’ would take in Java.

Python is a language that most people consider easy to learn though it still finds use in ‘big’ software companies like Google: “Python where we can, C++ where we must” (Holderness, 2016) and in games like EVE Online, Battlefield, Mount&Blade, or Civilization IV (Boddie, 2013). Thus, we consider Python as an industry-relevant language. Unlike other languages proposed for teaching to novices, Python is not just a teaching language, it is a language that is suitable for developing real-world applications (Radenski, 2006). An important goal of the Python developers is making Python fun to use, as also can be noticed by the origin of its name, while focusing on code readability, extensibility, and clear error message handling (The Python Software Foundation, 2017). Focusing on gaining insight into what it is really like to code and at the same time considering the shallow learning curve of Python, leaves us at the conclusion that Python is a good start for beginners without prior coding experience.

4 Results

In order to clarify the developed structure we divide the topic into its three major components in this chapter. First, we will present the organization of the lectures, which consist of four parts: plan, do, check, and act. Secondly, we will draw up a timeline of the progress of the lessons, tackling the curriculum apportionment and the general concept of introducing students to new knowledge. In the last part of this chapter, we will introduce the educational content, the means of the playful approach, and the main design principles for an educational game.

4.1 Organization of the Lectures

The lecture optimally is held by an experienced teacher with previous experience in the playful teaching approach, as well as extensive knowledge in computer science and coding. Computers with the pre-installed software are provided by the school, but the students should still be encouraged to bring their own laptops in order to be able to take notes, and to code in their own environment, as they would back home on their own. Every school student should play and code independently.

In the first five minutes of each unit, the teacher repeats the knowledge learned in the last unit, combined with an outlook to what students are required to learn in the current unit, and how it is connected to previous knowledge. As the students will have progressed at different speeds and hence be at different levels of knowledge, the repetition is based on their remarks and input. The underlying idea is to not set a common learning goal for the students for each unit, but to clear up eventual difficulties with previous contents. The students themselves set interim learning goals (**Plan**).

During the course of each unit the teacher helps and coaches the students if needed. The teacher does not need to approach students but let them work independently in order to give them the freedom to solve problems on their own. The aim behind this endeavor is fostering their motivation, self-value, and to increase their confidence in their own skills. A solution for a problem should not merely be offered by the teacher, but be worked towards together (**Do**).

The last five minutes of the units are for a short repetition of the current content in order to gather more information on the difficulties the students experienced and how they felt about the learning process while playing the game. The students should use the time for self-reflection (**Check**). The teacher provides handouts for each stage of the game to give the students something tangible to study and base their learning effort on before the exam. In order to keep track of the school student's progress, homework will be assigned to the students. To ensure quality, one of the underlying concepts of this approach is the Plan-Do-Check-Act Cycle (PDCA)¹ of W. Deming (Deming, 1986) as illustrated in Figure 1, showing the general lesson structure.

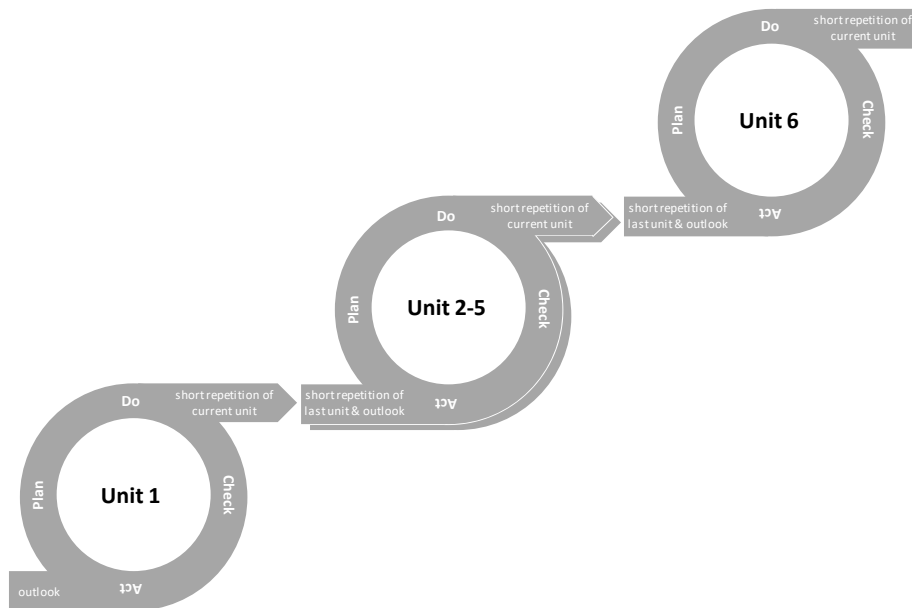


Figure 1: General lesson structure (own illustration)

The students will receive instant feedback on their code by the game. The teacher should help if difficulties come up and the students cannot solve a problem based on the feedback of the game or do not understand the error messages. By observing the students play, the teacher will also be able to identify complications in the game-play or during the execution of coding tasks (**Act**).

4.2 Lesson Structure

The length of each lesson is 45 minutes as it is custom in the German school system. The time planned for computer science, and more specifically to teach how to program, are six lessons, spread over the course of six weeks. In the Bavarian technical upper vocational schools, the course is mandatory for the students, most of which have no prior experience in coding. In this chapter, we explain the specific content of each lesson.

Whenever possible, concepts should be introduced completely and at once, as an exception some concepts are initially introduced in a limited fashion and then revisited in a later topic for full coverage (Radenski, 2006). The lesson structure introduces the students to different concepts and knowledge about coding with a gradually advancing learning curve. The content is structured to build on previous knowledge learned in earlier units and allows for a start without any prior coding experience. The lesson structure is adapted to the curriculum set by the Bavarian Education Ministry and the pre-defined situational and environmental circumstances in the school. The course is divided into six individual units, which are presented in the following and summarized in Table 2.

1st Unit

Students are introduced to coding and its use in our daily lives. The educational game will be implemented and its controls will be explained. Beginning with small pieces of code the school student gains knowledge on how to handle the IDLE Python GUI editor to be able to solve tasks and experiment at home on his own. Basic knowledge about assignment of values to variables, mathematical operators, and output, as well as basic data types including integers, floats, and strings.

2nd Unit

The students learn about boolean values and conditional structures to give software the ability to react on different types of input. The students learn basic commands to handle arrays and to calculate with boolean operators. The goal is to deepen the knowledge about dealing with different types of output and data while introducing branching structures. Manipulation of arrays and decision structures based on boolean variables, or by analyzing the input, complete this chapter.

3rd Unit

The third lesson will give a deeper understanding and further foster the ability to handle more complex data structures. More commands in order to handle arrays are given, such as sorting, reversing, inserting, indexing, and popping elements in arrays. This will be combined with handling the “for”-loop functionality. Iterating over arrays and building decision structures to connect the new knowledge to the 2nd Unit are at the core of this

unit. Students learn how to break down a problem into smaller parts and separate problems in order to be able to find solutions for a bigger task.

Table 2: The six units of the lesson structure

Unit	Content	Goal
1	Introduction to coding in the IDLE Python GUI and to the educational game, output, operators and types of variables such as string, integer and float	Ability to handle the coding tools, first introduction to basic coding and the educational game
2	Introduction to boolean values and arrays, conditional structures	Ability to deal with different types of output/input and connecting basic knowledge of mathematics to programming structures
3	Complex data structures, for loop and array handling	Advancing complex code structures, iterating and building extensive decision structures
4	Repetitive use of code by learning about methods and classes	Object oriented programming, describing virtual objects by setting attributes and implementing functionality
5	Use of classes, instances, parameter transfer, return values in functions	Systematic design of software, readability and transparency of the code
6	Repetition by connecting previously learned knowledge with complex tasks	Discover and close gaps in knowledge, deepen the comprehension of the content

4th Unit

In this unit, the students learn about repetitive use of code using methods and classes. Methods are introduced in a functional coding style and afterwards connected to classes. Classes will be used as a way to describe objects in a compact way and give functionality to them in order to change their attributes based on input and parameters as well as handling the interaction between classes. Examples of their use will be given and students are expected to add functionality and attributes to an existing class before creating a class on their own.

5th Unit

This unit focuses on knowledge about classes while introducing new features involving multiple instances and parameter transfer as well as optional return values. Furthermore, the while-operator in connection with boolean operators and values will be introduced.

The emphasis of this unit lies on good systematic design of software to ensure readability and transparency of the code.

6th Unit

The last unit holds no more additional new knowledge but means to give students the tools to code on their own in the future. It combines previous knowledge of the first six units. The students are given complex tasks in order to recognize potential in coding. The goal of the unit is to discover knowledge gaps in order to help students repeat or deepen specific units in order to achieve full understanding of given code.

4.3 Game, Features, and Educational Content

An educational video game is being developed with the single goal of connecting the curriculum (of how to program) with a game that is interesting and fun to play; and simultaneously puts learning into perspective and gives incentive to learn more. The students will be able to see that their own learning environment was created by using the same knowledge they will have at the end of the course. Furthermore, by creating an educational game for learning how to code in a gameplay setting, which resembles widely used and popular interactive development environments (IDE), could incite the motivation, self-esteem, and knowledge in students to carry on coding on their own. Necessary features in an educational game can easily be derived by approaches to satisfy the success factors for the PLA (Heininger et al., 2017): motivation, integration and involvement in class, the audience-centred focus, giving feedback and enhancing interaction, and the fluent integration of the educational content into the gameplay.

Main design principles for an educational game can also be derived from the iterative processes of conducting case studies by other authors and evolving and improving an educational game: interaction and iteration of those interactions, adaptive and personalized feedback, clear winning criterion, and no or few opportunities to cheat the game (Tillmann, De Halleux, Xie, Gulwani, & Bishop, 2013). Those criteria have been confirmed by another often cited study of educational games proposing practical steps for designing educational games (Linehan, Kirman, Lawson, & Chan, 2011). A good game is easy to learn but hard to master (Prensky, 2002) meaning the handling of the basic game is easy, but to be good at it becomes more and more difficult the further you advance. The playful approach motivates the students to become more interested in their own education and willingly sacrifice time for it. The game achieves this by students having to work for their knowledge by beating the game, defeating numerous enemies and mastering obstacles.

A basic rule of good game-play is to provide the player always with clear short-term goals (Prensky, 2002). In an educational game, this may mean partly beating enemies, collecting coins and jumping over obstacles, but also means solving coding tasks to advance in the gameplay. Beating enemies and collecting coins may obviously not have

a direct impact on the students learning success, but very well can create the joy and motivation to keep on playing, and thus to keep on learning. Examples of collectibles for the sake of their own can be found in numerous games: coins in the Mario series, spraying graffiti in GTA San Andreas, or visiting viewpoints in the Assassins Creed series. Players often do not try to find all collectibles for the purpose of getting a reward but for the sheer pleasure of the treasure hunt. After all, games are supposed to be fun and not purely work.

5 Conclusion

Based on former research, concerning the success factors for teaching with a PLA (Heininger et al., 2017) we were able to develop a lesson structure which shows the structures used for a playful approach to teaching. The content is based on the curriculum for technology classes of the Bavarian technical upper vocational schools, as well as Bavarian school norms. However, it can be transferred to other types of schools and curricula as well by customizing the proposed structure to fit different circumstances, such as timeframe of a lesson, length of course, programming language, and previous skill level of students. The lesson plan can be especially useful to be implemented in different German vocational schools, but also in other cultures as the structure's core is based on outcome-based learning, which was analysed and evaluated by Biggs and Tang (2007) and is used worldwide as a framework for good teaching and assessment. The curriculum was adapted to Python and its specific language constructs. The development of an educational game as an exemplary playful learning approach would be based on the structure created and paired with the educational content of the curriculum. The educational game as an electronic learning platform brings together practice (learning how to program), teachers (as a supporting entity, rather than lecturer), scholars (providing the theoretic foundation and practical knowledge based on previous case studies), and students (as active participants in their own education) in one environment.

We chose python as the favourable programming language based on its compactness and intuitiveness, which makes it easy to learn and to use for beginners. Whenever possible, concepts are introduced completely and at once, as an exception some concepts are introduced in a limited fashion and later revisited for full coverage (Radenski, 2006). A professional teacher, who is experienced in the topic of computer science, optimally accompanies the lecture. Five minutes in the beginning as well as at the end of each lesson are used to repeat the knowledge of the last lesson, respectively to recap the knowledge learned in the current lesson.

The use of an educational game as shown in this paper and the implementation of a playful teaching approach in a case study at a Bavarian upper vocational school will be part of the research in the future in order to validate the lesson structure.

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Notes

1 Originally introduced as *Plan – Do – Study – Act* (PDSA)

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Emerging Smart Technologies and the European Standardisation System

KAI JAKOBS

Abstract The standardisation of smart applications and the underlying smart communication infrastructure represent new challenges for European standardisation. This paper identifies and discusses a number of policy issues that the European Standardisation System (ESS) faces or is likely to face in the not-too-distant future. A number of potential steps that the ESS could take to help resolve these issues are sketched.

Keywords: • Smart Applications • Smart infrastructure • European Standardisation •

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1 A Very Brief Introduction

“Standards are not only technical questions. They determine the technology that will implement the Information Society, and consequently the way in which industry, users, consumers and administrations will benefit from it” [EC, 1996; p. 1]. This quote conveys two important insights that are overlooked all too often:

- ICT systems simply would not work without underlying standards.
- Today’s (ICT) standards are tomorrow’s technology – those that develop (ICT) standards today at the same time shape much of the (ICT) environment we all will use in the future.

This holds for ICT standards in general and for standards for ‘smart’ technologies in particular. Basically, the ‘smartness’ emerges from the incorporation of ICT-enabled capabilities into ‘traditional’ applications; ‘Smart Manufacturing’ and ‘Intelligent Transport Systems’ (ITSs) are cases in point. In general, such smart technologies result from the merger of different technologies. The former integrates, among others, production engineering, robotics, control engineering and ICT; the latter transport telematics, traffic engineering and ICT. These applications will deploy a ‘smart’ infrastructure, comprising Cyber-Physical Systems (CPSs) and deploying the Internet of Things (IoT) for communication.

These merging technologies represent a considerable problem for standardisation. They will require co-operation between standardisation entities with very different cultures, from equally different backgrounds and used to very different technology life cycles. While this is a general problem, this paper aims to contribute to an answer to the question how well the ESS is likely to fare in this increasingly important and complex environment. Is it future-proof? And if it isn’t – what needs to be done to change that? The remainder of the paper is organised as follows. In sect. 2, a SWOT analysis is used to discuss the ESS. The resulting policy issues are addressed in sect. 3. Finally, sect. 4 presents a rudimentary roadmap and outlines some future steps that the ESS might consider taking to overcome these issues.

2 The European Standardisation System – A SWOT Analysis

The SWOT analysis of the ESS aimed at the identification and analysis of the major standardisation-related issues in general and in the field of smart infrastructure and applications in particular. Tables 1 and 2 show the outcome.

Table 1: SWOT analysis of the European standardisation system (general)

<p>Strengths</p> <ul style="list-style-type: none"> • A contradiction-free standards system. • Well-established, consistent system with close links to European policy makers. • Close and long-standing co-operation with international counterparts and major NSOs (CEN, CENELEC). • Well respected internationally (ETSI). • Pioneers in innovative approaches towards standardisation (ETSI). 	<p>Weaknesses</p> <ul style="list-style-type: none"> • (Financially) dependent on policy makers. • So far, process not 100% suitable for fast-moving technologies (CEN, CENELEC). • Overly European focus (CEN, CENELEC). • Sub-optimal type of representation (through national delegations; CEN, CENELEC). • Very much a ‘rubber-stamping’ (of IEC standards) entity (CENELEC). • Limited links between research and innovation (R&I) and standardisation. • Low emphasis on standards education.
<p>Opportunities</p> <ul style="list-style-type: none"> • Contradiction-free standards will help sustain the single market. • Good links to international bodies can strengthen the EU position in the global arena. • High reputation attracts both European and international know-how, contributions and members (ETSI). • Higher democratic legitimacy may increase relevance associated with European standards (CEN, CENELEC). 	<p>Threats</p> <ul style="list-style-type: none"> • Financial dependency on policy makers may lead to even stronger European focus and thus reduced international importance (CEN, CENELEC). • The newly imposed focus on speed may be counter-productive when it comes to high-quality standards for long-lasting infrastructures. • Inadequate links between R&I and standards setting hinders exploitation of state-of-the-art technical knowledge, may render European standards inadequate and may delay ESOs from addressing crucial future topics. • Mostly ‘rubber-stamping’ of IEC standards will reduce European visibility and influence in this body. • Increased market fragmentation through inadequate incorporation of consortium standards into the ESS.

Table 2: SWOT analysis of the European standardisation system (for smart applications and infrastructure)

<p>Strengths</p> <ul style="list-style-type: none"> • Well positioned in the telecommunication sector (ETSI). • Long-standing activities in ITS (CEN). • Several NSOs are very active on smart applications (e.g. the German DIN on Smart Manufacturing and the British BSI on Smart Cities). • Adequate expertise is available on smart infrastructure/applications (between ESOs and NSOs). • Inclusive approach. 	<p>Weaknesses</p> <ul style="list-style-type: none"> • Very limited activities on smart applications at European level (all ESOs), infrastructure (CEN, CENELEC) and CPSs (all ESOs). • Hardly any formal entities (Technical Committees (TCs), Working Groups (WGs)) in place to address ‘smart’ aspects (CEN, CENELEC). • No visible approach towards multi-disciplinary standardisation (all ESOs). • Implementation aspects are not considered (mostly CEN, CENELEC). • Hardly any formal links to non-European entities (except ISO/IEC) for all smart applications and the IoT (CEN, CENELEC).
<p>Opportunities</p> <ul style="list-style-type: none"> • The combined expertise of NSOs and ESOs should be sufficient to assume a leadership position in some smart applications. • The accommodating attitude towards SMEs and ‘non-traditional’ stakeholders (e.g. NGOs) should be an asset in the field of smart applications. 	<p>Threats</p> <ul style="list-style-type: none"> • Lack of adequate level of activity on smart applications/infrastructure may lead to marginalisation in these crucial domains (CEN, CENELEC). • The widely held belief that ICT standards in general and IoT-related ones in particular should be global may render regional bodies less relevant (CEN, CENELEC). • Lack of links to international Standards Setting Organisations (SSOs; specifically to consortia) may also contribute to future marginalisation in the field (CEN, CENELEC). • Retained mono-disciplinary approach may contribute to reduced interoperability, e.g. between infrastructure and applications. • Failure to consider implementation issues may nullify any potential first mover advantages.

The tables show that both strengths and weaknesses of the ESS result from it being a well-established, long-standing system. On the one hand, good relations with policy makers and their international counterparts together with time-honoured (and bureaucratic) processes have made CEN and CENELEC major players in many fields and entities to be reckoned with. In addition, a contradiction-free set of standards is a major asset.

Yet, such systems tend to become self-complacent. For example, until very recently the ESS largely ignored the importance of private standards consortia in the ICT sector. A fairly recent European Regulation [EU, 2012] certainly points in the right direction on this and several other aspects, but it still remains to be seen how things will develop in practice. Specifically, it is still unclear how (and if) the call for both greater speed and more inclusiveness can be answered in practice. That said, greater speed is not a desirable feature per-se. In particular, supposedly long-lived technologies like e.g. communication infrastructures may well benefit from a longer, more thorough and less error-prone process that involves all stakeholders. Inclusiveness would be of special importance for smart applications, where many stakeholders will be involved that are typically absent from ‘normal’ ICT standardisation (e.g. city authorities or NGOs). Moreover, it remains an open issue how the contradiction-free system is to be maintained in the face of the likely wealth of consortium standards eventually used and referenced.

From the SWOT analysis it also would seem that there is a real risk of international marginalisation of at least CEN and CENELEC in the fields of smart infrastructure and, particularly, applications. This is primarily due to:

- Overly strong European focus
If this focus leads to inadequate international links the situation will become worrisome. This will hold especially if it occurs in a field where global standards (possibly with regional adaptations) are a sine-qua-non.
- Limited activities on smart applications
Limitations materialise in two ways. Most notably, CENELEC focuses the majority of its activities on transposing IEC standards into European ones. Secondly, with the exception of ITS, the ‘smart’ aspects of applications have largely been ignored so far; foci, if any, are on the underlying communication side.

The latter is all the more surprising as one of the ESS’ strengths is its close link to policy making. This could be exploited through new European standards setting activities that focus on the upper layers of smart applications. Here, the associated governance aspects imply the needs for such close links between standardisation, government and policy making.

Unfortunately, some of the perhaps less obvious issues that may nevertheless have potentially considerable long-term ramifications do not get the attention they deserve.

These include primarily the link between R&I and standards setting and the education about standardisation. A weak link to research may imply that important findings never make it into the standardisation process and that, accordingly, standards will be developed that do not take into account the state-of-the-art. As a result, such standards will either not be taken up by the market or be very soon superseded by others. Inadequate (or rather, virtually non-existing) education about standardisation may, in the medium to long term, lead to (at least initially) poorly equipped European standardisers in the international arena.

3 Policy Issues

This section looks at some of the issues the ESS faces or is likely to face in the near future. This includes some general ones as well as a number of aspects that relate specifically to the standardisation of smart infrastructures and applications.

3.1 General European Standardisation Issues

European standardisation still needs to deal with a number of issues that were identified already many years ago and have been discussed ever since, but in several cases without a satisfactory outcome. These include the need for speed in standards. But speed is not a value in itself. If it supports the timely production of a standard, speed will be beneficial. Otherwise, it may stand in the way of quality and completeness. Accordingly, the popular unqualified focus on speed needs to be questioned. In addition, achieving both ‘speed’ and ‘inclusiveness’ is next to impossible – the larger the number of interested parties around the table, the longer it will take to reach consensus. A case-by-case balance needs to be struck – ‘speed’ must not be the overriding issue when it comes to e.g. standards for security and privacy in smart applications and ‘inclusiveness’ must not be the show-stopper for standardisation of e.g. interfaces to peripheral devices. That is, the necessary and desirable levels of inclusiveness and speed vary between standards (see also e.g. [Sherif, 2003]).

The link between R&I and standardisation is another long-standing issue, which also links to education about standardisation. The European Commission’s recent ‘Joint Initiative on Standardisation’ [EC, 2016a] is but the latest attempt to overcome the barriers that still exist between standardisation, innovation and education and the respective communities. Its eventual outcome remains to be seen. In any case, without a closer integration of these domains neither policy makers nor industry will be able to reap the full benefits standards and standardisation offer.

Close links between policy making and standardisation exist in the EU. This is a bit of a double-edged sword, though. On the one hand, some standards are not so voluntary anymore (especially in the field of public procurement). “If the producer does not manufacture in conformity with these [harmonised European] standards, he has an obligation to prove that his products conform to the essential requirements” [CEU, 1985].

On the other hand, these links may well be beneficial when it comes to the standardisation of smart applications where regulatory aspects may well play a role.

3.2 European Smart Application/Infrastructure Standardisation

From a standardisation perspective, the development over time in both the application areas and the infrastructural technologies show considerable similarities. In all cases, the complexity of the respective web of SSOs has increased dramatically over the past 20 years, as has the number of relevant entities within individual SSOs (TCs, WGs, etc.). The most notable proliferation of such entities could be observed for the past five to seven years, with the exceptions of ITS and mobile communication, where the development was more homogeneous and far less pronounced peaks occurred around 2005 and in the late 2000s, respectively [Jakobs, 2017].

Another similarity lies in the fact that in all cases but one the establishment of formal SDOs (typically working on predecessor technologies) predate those of consortia by decades (ITS being the exception). Overall, it would seem that up to now consortia play a less important role in the development of smart applications and IoT-related technologies than they do e.g. in the mobile communication sector.

ICT systems span the globe and, by definition, the associated standards need to be global as well. The task of regional standards then is to introduce regional specifics (of e.g. regulatory nature) into international standards, while maintaining global interoperability. Alternatively, some such regional specifics may find their way into international standards. However, both cases require dedicated regional standardisation activities.

Against this background, a look at the developments in Europe yields a somewhat ambivalent picture. On the bright side, ETSI's activities on smart applications and, particularly, smart infrastructure through its smartM2M TC and its Partnership Projects (3GPP, oneM2M) are well positioned in the global context. However, the focus is on rather more low-level wireless telecommunication services. On the other hand, the eight CEN Technical Committees identified as being active in the field of 'Smart Technologies' in [CEN/CENELEC, 2016] focus almost exclusively on metering and do not really link to ICT, the IoT or CPSs. The one exception is CEN/TC 294 (Communication systems for meters). However, as the name suggests the focus here as well is on the communication system. Perhaps more notable, CEN has long been playing a prominent role in the ITS sector, also covering more application-oriented services. Apart from that, however, CEN and CENELEC seem to have adopted a 'laggard' role, with CENELEC largely focussing on the transposition of international standards.

According to the 'Rolling Plan for ICT Standardisation' [EC, 2016b], CENELEC "works out methods for safe and secure communication protocols for wired and wireless industrial automation applications" in the field of Smart Manufacturing [EC, 2016b]. Yet, this work as well has so far mostly been limited to the adoption of IEC standards. Given the pioneering role that Europe in general and Germany in particular play in this field

(‘Industrie 4.0’; see e.g. [GTAI, 2014]), it seems a bit strange that such a leadership position should not be translated into indigenous European standards that could eventually be adopted by ISO or IEC. In fact, the apparent reluctance to play a more active role in smart manufacturing standardisation is also at odds with [EC, 2016a]. This document highlights Europe’s long standing leadership in factory automation and that standardisation has an important role to play in helping European industry to secure this leadership. The ESOS’ Coordination Groups on the Smart Grid, Smart Meters and Smart and Sustainable Cities and Communities, respectively, have so far been more policy advisory entities rather than actually active in standards setting. With respect to the IoT, CEN/CENELEC’s standardisation activities are limited to the field of automatic identification and data capture, where a newly (in 2016) formed WG addresses IoT related issues.

In this context, the lack of any approach towards truly multi-disciplinary standardisation is worrying. It is also surprising since the European Commission has identified the need for such an approach in [EC, 2016b]. The document calls for multi-disciplinary standardisation in several application areas, including Smart Grid and Smart Cities.

Given the almost frantic activities that are going on at the international level this seemingly rather restrained European approach (at least for smart applications) appears a bit odd. In fact, it is in stark contrast to the recommendations made already in [ProSE, 2011]. While these recommendations relate to the field of embedded systems (the not necessarily interconnected predecessors of CPSs), they are equally valid for the standardisation of the IoT and smart applications. The relevant ones (in this context) read: “Recognise the need to value standardisation and to take leadership of standardisation (in appropriate domains).

Recognise the need to co-operate on standardisation across competitive boundaries and to reconcile and manage the differences that presently inhibit such co-operation.
Invest in the efforts required to bring about standardisation, allowing staff the time and support to bring about long-term benefits.

Invest in people and RTD in order to feed the technology pipeline that provides the basis for standardisation”.

The above recommendations should be applied at least to those sectors where Europe has assumed – or aims to assume – a leadership position, technologically and/or in standardisation. Specifically, this holds for the ITS sector, where CEN has been (co)-leading the way for a number of years now. Likewise, existing strengths in Smart Manufacturing should be exploited in the standardisation arena (beyond Additive Manufacturing, which is covered by a CEN TC).

4 Potential Future Steps

4.1 A Very Rough Roadmap for the ESOs in the Field of Smart Infrastructure and Applications

This section aims to deepen these insights by identifying actions potentially to be taken by the ESOs to meet external challenges. Fig. 1 shows the underlying framework.

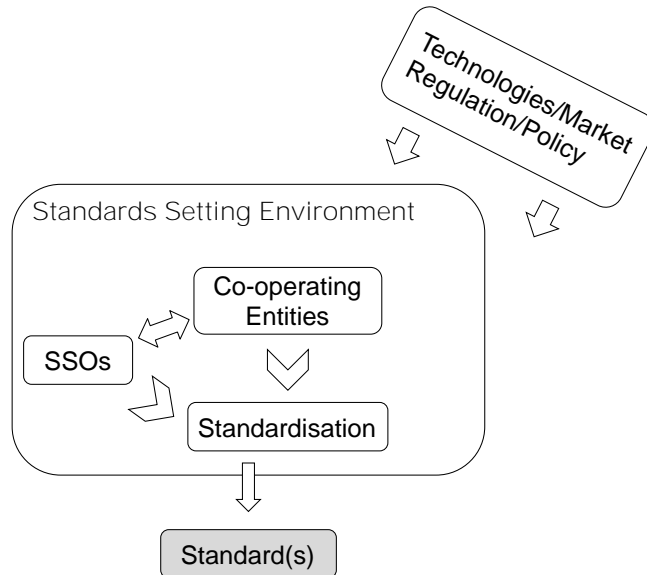


Figure 1: The roadmap's framework

In an environment characterised by uncertainties a roadmap offers a visual representation of alternative paths towards a strategic goal or a vision (see e.g. [Phaal & Muller, 2009]). Here, the overall goal is a global standardisation environment within which the ESOs play a central role in the standardisation of a smart communication infrastructure and smart applications. To this end, a number of external influences have been extracted from a literature review, a survey⁸ and the SWOT analysis. They are depicted in Fig. 2, along with the associated actions to be taken to adequately address them and to eventually make the vision a reality.

It would appear that two already ongoing trends – strong Asian/Chinese participation in standards setting for smart applications and infrastructure and the need for truly interoperable implementations (as opposed to standards) – may well imply a further reduction of the ESOs' international importance (specifically of CEN and CENELEC). The same holds for the possible (likely?) trend towards all-IP networks (see e.g. [Jara et al., 2013]). This is hardly going to happen anytime soon, but may well be expected in the medium term. The same holds for a wider deployment of CPSs and of smart applications. Given the current fragmented standardisation landscape and the infancy of the associated

standards setting activities, these developments are a) unlikely to be aligned and b) likely to deploy proprietary technology. However, this may increase the need for interoperability and thus for international standards. This, in turn, would represent an opportunity for the ESOs if they managed to position themselves as relevant players in the meantime.

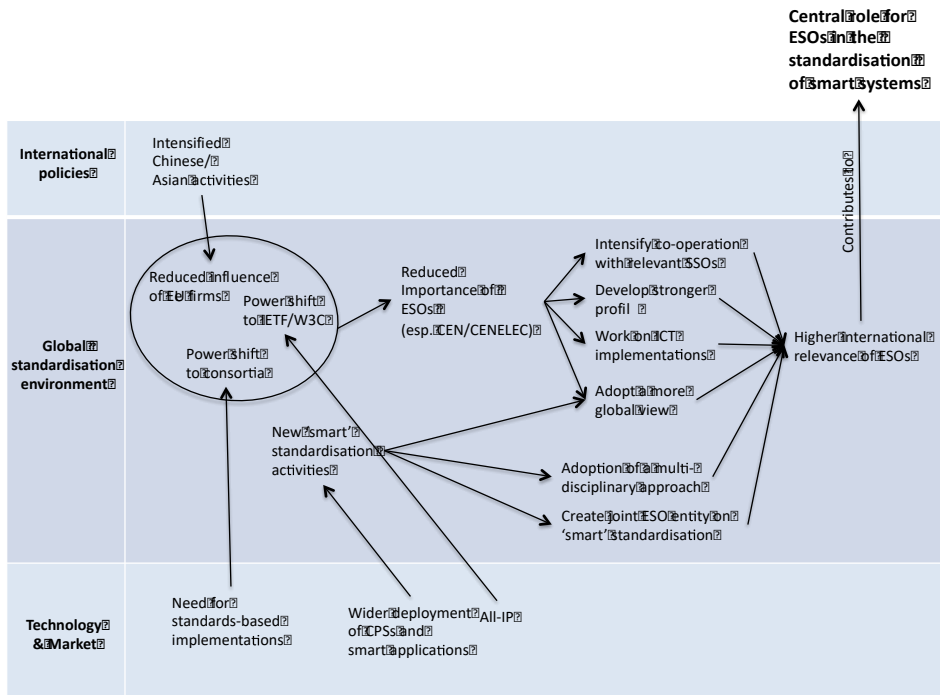


Figure 2: A very rough 'roadmap' for 'smart' standardisation

Fig. 2 shows that the ESOs do not always play the role they could play in the standardisation arena for smart infrastructure/applications. The SWOT analysis revealed a number of issues that need to be addressed. These issues fall into three categories (not all apply to all ESOs):

- Limited relevant activities. This has two dimensions. For one, not all relevant technical areas are covered by the ESOs. Moreover, especially CENELEC frequently limits its activities to the transposition of IEC standards into European ones.
- Inadequate international interconnectedness. While very good links exist to the ESOs' respective international counterparts the same may not be said for private international standards consortia.
- Process aspects.

- This refers to limited links to relevant research activities, to the equally limited activities in standards education, to the disregard of implementation aspects and to the lack of multi-disciplinary standardisation.

These weaknesses will be discussed in the following.

4.2 Limited relevant activities of the ESOs

A number of gaps in the ESOs' standards setting activities may be identified in the realm of smart infrastructure/applications. For one, with the exception of ETSI's smartM2M group (and its involvement with oneM2M) hardly any activities are to be found. This comes as a bit of a surprise since both CEN and CENELEC have been venturing into the field of communication systems (e.g. in ITS (CEN) and for the smart grid (CENELEC)). Moreover, a smart infrastructure (including particularly the IoT and CPSs) is the basis for all smart applications. Similarly, the activities relating to smart cities are in their infancy at best. Given the necessary tight integration of standards activities on smart applications on the one hand and a smart (communication) infrastructure on the other it would seem that joint ESO activities in the 'smart' realm are called for. How exactly such joint activities may look like would have to be discussed. Joint CEN/CENELEC entities have already been established (TCs, WG, Workshops); an extension of this concept to also include ETSI should be considered. This would, on the one hand, strengthen the expertise on the communication side and support multi-disciplinary and integrated standardisation (of applications and infrastructure) on the other. Along similar lines do the virtually non-existing global standardisation activities for CPSs represent an opportunity for Europe. Research in this field has been going on for quite a while now in Europe. This accumulated know-how could be used as basis for European standardisation activities, also e.g. through a TC managed jointly by all ESOs.

The other issue relates to the fact that in many cases CENELEC's main activity seems to be the transposition of IEC standards. For example, in the field of Smart Manufacturing almost all but ten (out of 250+) standards passed by CLC TC65X originated from the IEC. It certainly makes sense not to unnecessarily duplicate any work. However, the thought of CENELEC standards solely being based on IEC documents for both ITS and the Smart Grid is a bit worrying. After all, there are European specifics, most notably in the highly regulated field of the Smart Grid. Specific European boundary conditions may also be assumed for e.g. Smart Cities. A higher level of autonomy in these fields is called for.

4.3 Inadequate international interconnectedness

The focus of both CEN and CENELEC is clearly on Europe. This is not a bad thing per se for an ESO. However, the ICT sector is, almost by definition, global. Accordingly, in this sector, which includes smart infrastructure and applications, globally accepted standards are a sine-qua-non. The European Commission has realised that; the Regulation on European standardisation [EU, 2012], which notes that "... the Union should

encourage contact between European standardisation organisations and private forums and consortia, while maintaining the primacy of European standardisation”. Nevertheless, CEN and CENELEC together have so far established links with only four international organisations that are of some relevance for the standardisation of smart infrastructure and applications. It may be assumed that this isolation also contributes to the fact that regional standards bodies’ importance in the field is seen as either limited to the identification of specific regional requirements and the associated adaptation of global standards or is questioned altogether [Jakobs & Wehrle, 2017]. As a first step, links to relevant non-European players should quickly be established through formal co-operation and co-ordination mechanisms.

4.4 Process aspects

A number of rather diverse aspects fall under this heading. For one, the need for education about standardisation has been highlighted by several sources. Recently, the EU’s ‘Joint Initiative on Standardisation’ observes that “... there is a clear need to explore and promote standardisation as an element of formal education, academic & vocational training, ...” [EC, 2016a]. So far, in Europe coverage of standardisation has been very limited in tertiary education. Continuous education is primarily provided by the NSOs and typically focuses on the practical aspects of standards setting, as opposed to e.g. economic or other academic ones. The problem has long been realised; a ‘Joint Working Group on Education about standardization’ was established by the ESOs in 2010. However, the group has been dormant for quite a while. Work on the ‘Programmes for education in Standardisation/Training and awareness on standardisation’ [EC, 2016a] has commenced after initial difficulties; its outcome remains to be seen.

Moreover, links between standardisation and Research & Innovation (R&I) need to be improved. This issue has also been on the agenda for quite a while now. Both the ‘Interest’ [Interest, 2007] and, more recently, the ‘Bridgit’ project [Bridgit, 2014] made a number of similar recommendations on how to bridge the gap between standardisation and R&I. In unison, they highlight the need to increase awareness on both sides and to mutually promote and educate. Likewise, incentives need to be offered to researchers to spend resources on standardisation activities; this should be of relevance for research funding organisations (including the EU). For the ESOs, this would include adapted or new processes that are more ‘research-friendly’, i.e. short-lived (akin to e.g. IETF Working Groups). CEN/CENELEC Workshops and ETSI’s Industry Specification Groups are certainly steps in the right direction. However, their usefulness is limited by the fact that no mechanism exists to feed their output into the standardisation process proper (e.g. through the transition of a CEN Workshop to a Working Group). Taking the various recommendations made by the two projects on board would definitely help improve the situation.

Not unlike their international counterparts, both CEN and CENELEC stay clear off any implementation aspects. The situation for ETSI is slightly different; their ‘Plugtests’ represent at least a step towards taking implementation issues into account. In any case,

the success of SSOs like the IETF and the W3C may to no small part be attributed to the fact that they consider implementations and proven interoperability as part of their respective standardisation process (see e.g. [Lehr, 1995]). It seems highly unlikely that CEN and CENELEC will change their stance on implementations. Nevertheless, at least for the ICT sector steps ought to be taken to provide the market with what it needs – interoperability. Perhaps a new entity that develops and/or certifies interoperable implementations might be a way forward.

The lack of multi-disciplinary standardisation is another issue. The need for such a new way of setting standards for the field of smart infrastructure and applications has been corroborated by survey respondents in [Jakobs & Wehrle, 2017]. A standards setting platform jointly managed by the ESOs has already been suggested above. Such a platform would have the potential to kill two birds with one stone. On the one hand, it would help improve the level of the ESOs' involvement in the international standardisation of smart infrastructure and smart applications. As the European expertise from the different relevant fields would likely be concentrated on this platform it would also contribute to the goal of multi-disciplinary standardisation. A 'third bird' would be the fact that such a major 'hub' of standardisation in the 'smart' field could also attract other SSOs to enter into co-operation agreements. Such a platform would allow experts from different backgrounds and from several SSOs to meet and to address inherently multi-disciplinary standardisation problems (eventually not necessarily limited to smart infrastructure and applications).

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Intruder Alert? How Stock Markets React to Potential IT Security Breaches: The Case of OpenSSL Heartbleed

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Abstract This exploratory study investigates how potential information technology security breaches affect stock prices. Previous research indicates that stock markets tend to punish firms that experience unsolicited disclosure of information and proprietary data. However, little research exists on the question of whether firms are punished for creating the mere potential for data theft. Based on the information boundary theory, we design our exploratory research model. Subsequently, we utilize a sample of 4,147 stocks of firms headquartered in 43 countries to conduct multiple event studies. We reveal a delayed adverse stock market response to potential IT security breaches as well as a discrimination among firms operating in different industries. Consequently, this work enhances the understanding of the full economic impact of information security measures by shedding light on previously neglected hidden costs.

Keywords: • Economics • Finance • Information Security • Event Study • Heartbleed •

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1 Introduction

Hardly a day passes without reports of large-scale attacks against IT infrastructures launched by internal and external perpetrators. These attacks frequently result in the unintentional disclosure of confidential information and proprietary data (Liedtke 2014, Zetter 2013).

Previous research on the economic impact of IT security breaches on affected firms focuses on realized unsolicited disclosure of information and proprietary data (Acquisti et al. 2006, Campbell et al. 2003, Cavusoglu et al. 2004, Ettredge and Richardson 2002, Goel and Shawky 2009, Hovav and D’Arcy 2003, Kannan et al. 2007, Telang and Wattal 2007). However, we argue that it is equally likely that stock markets punish firms for creating the mere possibility of a data theft. This is because of a diminished trust in the firms' capabilities to protect sensitive data with adversarial effects on future sales and thus its stock price, which resembles the discounted value of expected future dividends (which are directly linked to sales). Thus, within this study, we examine the overall research question of the impact of potential IT security breaches on stock prices.

We draw on information boundary theory (IBT) to investigate our research question. Specifically, we study the impact of the Heartbleed vulnerability within the widely used cryptographic library OpenSSL (OpenSSL 2014a) on the value of 4,147 publicly traded firms. OpenSSL is used to secure connections in computer networks (Durumeric et al. 2014) and was enabled on approximately two-thirds of all webservers worldwide when Heartbleed was publicly announced (Goodin 2014). Examples of affected services include Facebook, Instagram, Google Search, Gmail, Youtube, Yahoo Search, Yahoo Mail and Dropbox (Mashable 2014). Our exploratory findings reveal a time-delayed response of stock markets to potential IT security breaches as well as a discrimination among firms operating in different industries.

The remaining portion of this paper is structured as follows. Section two provides background on related research, privacy theory as well as our research model. Section three provides information on our research methodology. Section four presents the results of our study and discusses its implications. Section five concludes the study.

2 Background and Research Model

2.1 Research on Realized IT Security Breaches

As summarized in Table 1, previous research can be largely divided into the impact of data & security breach announcements on firms and vulnerability disclosures on software vendors (Telang and Wattal 2007).

Table 1: Results of IT Security Related Event Studies by Covered Topic (Partially adapted from Acquisti et al. (2006) and Telang and Watal (2007))

Topic	Time Period	Events	Event Window	CAAR (%)	Author(s)
Firms	2000-2005	79	[0, +1]	-0.58	Acquisti et al. (2006)
	1995-2000	43	[-1, +1]	-1.88	Campbell et al. (2003)
	1998-2000	66	[0, +1]	-2.00	Cavusoglu et al. (2004)
	2004-2008	168	N/A	-1.00	Goel and Shawky (2009)
	1998-2002	23	[-1, +1]	N/A	Hovav and D’Arcy (2003)
	1997-2003	72	[-1, +7]	-3.17	Kannan et al. (2007)
	Feb. 2000	115	[+1, +3]	-3.00% ²	Ettredge and Richardson (2002)
Vendors	1999-2004	146	[0, +1]	-0.63	Telang and Watal (2007)

First, results regarding the overall impact of security & data breach announcements are mixed. While some authors find negative cumulative average abnormal returns (CAARs) of publicly traded firms’ stock prices ranging from -0.58% to -3.17% over short-horizon event windows below 10 days (Acquisti et al. 2006, Cavusoglu et al. 2004, Ettredge and Richardson 2002, Kannan et al. 2007) others don’t. For example, numerous studies find limited evidence of overall abnormal price effects but strong evidence for discrimination among firm and event characteristics (Campbell et al. 2003, Ettredge and Richardson 2002, Hovav and D’Arcy 2003). Campbell et al. (2003) finds no evidence for an overall effect but strong and statistically significant support for negative effects of security breaches that involve unauthorized access to confidential data (-5.46%). Exemplary for evidence of discrimination among the type of firms are Hovav and D’Arcy (2003), who find a statistically negative CAAR of internet-centered firms only and Ettredge and Richardson (2002), who find a negative CAAR of internet-centric firms. Second, software vendors that created vulnerable products were negatively affected and experienced a CAAR of -0.63% associated with the announcement of a vulnerability within their products and services (Telang and Watal 2007).

In summary, previous research focuses on the impact of realized IT security breaches. However, little research exists on the question whether stock markets punish firms for creating the mere potential to breach their IT security.

2.2 Heartbleed Vulnerability

On April 7th, 2014, the existence of Heartbleed, a vulnerability within the cryptographic library OpenSSL was publicly announced (Codonomicon 2014, Schneier 2014). Heartbleed is the result of an improper implementation of the Heartbeat Extension (Durumeric et al. 2014) specified in Request for Comments 6520 (RFC6520), and affects official OpenSSL versions 1.0.1 to 1.0.1f (OpenSSL 2014b). Heartbleed creates the

recurring possibility of unsolicited remote copying of small chunks of random memory content from a service without the need for any authorization or leaving any traces (Schneier 2014). Common Vulnerabilities and Exposures (CVE)-2014-0160 states that Heartbleed “allows remote attackers to obtain sensitive information from process memory via crafted packets that trigger a buffer over-read, as demonstrated by reading private keys“ (MITRE Corporation 2014).

Heartbleed was introduced to the OpenSSL codebase on December 31, 2011 (22:59:57 UTC) (Seggelmann 2012) and widely distributed on March 14th, 2012 with the release of OpenSSL version 1.01 (OpenSSL 2012). Grubb (2014) states that Heartbleed was discovered for the first time on or before March 21st, 2014 by Neel Mahta of Google Security (OpenSSL 2014b). Thus, the exploitation of fully patched services running OpenSSL was theoretically possible for approximately two years.

2.3 Research Model to Study Potential IT Security Breaches

The concept of privacy is considered to be of undisputed importance to societies of modern economies (Xu et al. 2008) and has been studied for centuries (Bélanger and Crossler 2011). However, grasping the concept of privacy is cumbersome because of its manifold definitions (Solove 2006). Acquisti et al. (2006) notes that attempts of precise definitions of privacy oftentimes “remain ambiguous, changing with the perspective of the observer”, a view that is shared by Introna and Pouloudi (1999). Nevertheless, in a landmark paper called “The Right to Privacy”, published in 1890 by Warren and Brandeis, the authors reasoned that the concept of privacy gradually evolved over time to “the right to be let alone” (Warren and Brandeis 1890). This view is still reflected by modern definitions with “the notion of privacy as freedom from the judgment of others” (Introna and Pouloudi 1999). Acquisti et al. (2006), defines a privacy incident roughly as a failure of mechanisms designed to protect personal information of customers’, partners’ or employees from threats of technical, managerial, organizational or human nature. The Heartbleed vulnerability thus represents an IT security related privacy incident.

IBT is the result of a research program to investigate the impact of monitoring and surveillance technology on the perceived privacy of workers (Stanton and Stam 2003). Xu et al. (2008) describes IBT as an explanatory framework that allows for studying social impacts of information disclosures: IBT states that people possess unique physical or virtual informational spaces. These spaces are limited by clearly defined boundaries. Attempts of external entities to cross these boundaries might be perceived as an intrusion into the informational space. The extent of this perception is dependent on situational and personal conditions (Xu et al. 2008). According to Stanton and Stam (2002), IBT represents the synthesis of three separate constructs: First, the communications boundary management theory (Petronio 1991). Second, the group value approach to organizational justice (Alder 1998, Alder and Tompkins 1997). Third, a general expectancy valence framework for privacy protection (Stone and Stone 1990). IBT is comparable to attempts of Moor (1997) to conceptualize multiple theories of privacy. IBT is in-line with the

reasoning that “the unifying feature of privacy incidents is the violation of certain expectations about how data will be handled” (Acquisti et al. 2006). Xu et al. (2008) show that IBT can be applied in an information privacy context to describe the formation of an individual’s privacy concerns.

Table 2 distinguishes two groups of firms by the overall news the public announcement of Heartbleed conveyed to firm stakeholders. Group A includes firms that were protecting their webserver by a vulnerable version of OpenSSL, allowing for the exploitation of Heartbleed. Group B covers firms that were protecting their webserver with an unaffected SSL/TLS solution.

Table 2: Groups of Firms by News Heartbleed Conveyed to Stakeholders

Heartbleed Group	Webserver Protected by SSL/TLS?	Webserver Vulnerable?	News to Firms' Stakeholders
Group A	Yes	Yes	Bad News
Group B	Yes	No	Good News

Research hypotheses set H1 deals with the overall impact of potential IT security breaches within Group A and B and is based on IBT. We hypothesize that firms within Group A experience a reduction in shareholders’ equity value, approximated by free-float stock prices, at the time of the public announcement of the Heartbleed vulnerability. Primarily because we assume that the announcement induced a re-assessment of firm stakeholders regarding the risk of unwanted information disclosure. This reassessment may result in a change in outcome from an acceptable- to an unacceptable risk as suggested by the IBT. This outcome is primarily driven by an increased perception of privacy intrusion induced by Heartbleed. In other words, stakeholders experienced negative news and responded with a decreased willingness to provide confidential information, which ultimately decreases business opportunity of affected firms. This reduced ability to conduct business will decrease future revenues and ultimately the amount of dividends a firm is able to pay out. Ceteris paribus (same dividend-pay-out ratios, overall growth projections and equity cost of capital) and assuming that stock prices are primarily determined by the present value of expected future dividend payments, this results in a decrease in stock value (Berk and DeMarzo 2011). The resulting research hypothesis, in which negative stock market reactions refer to falling share prices, is explicitly stated as:

H1a. Negative stock market reaction in Group A around the public disclosure of potential IT security breaches.

Additionally, we hypothesize that Group B firms experienced a positive effect on shareholders’ equity valuations at the time of potential IT security breach announcements. Especially because the knowledge that the firm was not affected by Heartbleed, despite being protected by SSL/TLS – may lead to a positive outcome of the re-assessment of the risk of unwanted information disclosure. This in turn attracts new

business opportunities through stakeholders, which previously assessed the risk as unacceptable. Furthermore, it is likely that stakeholders of Group A switched to Group B after assessing the risk of Group A firms as unacceptable, which again results in an increased ability of Group B firms to conduct business. Thus, and under the same assumptions regarding the effect on future dividend payments introduced in the last paragraph, this should result in an increase in the stock price of Group B firms:

H1b. Positive stock market reaction in Group B around the public disclosure of potential IT security breaches.

IBT states that people construct personal informational spaces within boundaries that – among other things – depend on the nature of information in question. We assume that firms in different industries process different types of information, of which some are considered of greater importance than others to the overall risk-evaluation process of firm stakeholders. For example, firms in the Communications or Financial Services industry may process more confidential information than firms in the Materials sector. Thus, we hypothesize that there are industry specific differences in the outcome of the re-assessment of the risk of unwanted information disclosure, which in combination with the reasoning of the last section yields the second set of hypotheses (H2):

H2a. Existence of industry specific differences in negative stock market reaction of firms within Group A around the public disclosure of potential IT security breaches.

H2b. Existence of industry specific differences in positive stock market reaction of firms within Group B around the public disclosure of potential IT security breaches.

3 Methodology

3.1 Event Study Design

Event studies are commonly used to examine the effect of specific events on the value of firms (Konchitchki and O’Leary 2011). While MacKinlay (1997) broadly defines event studies as “using financial market data [to] measure the impact of a specific event on the value of a firm“, others developed a more narrow understanding and note that “event studies examine the behavior of firms’ stock prices around corporate events“ (Kothari and Warner 2007).

In event studies, the timeline is divided into the estimation window, the event window and the post event window (Campbell et al. 1996). Returns are indexed in event time t , where $t=0$ represents the event date. Returns prior (post) the event date are typically indexed with negative (positive) integers relative to the event date (Acquisti et al. 2006, Campbell et al. 2003). At its core, event studies assess the effect of an event on the performance of a security in the event window by subtracting the expected return of a security from actual observed returns to get abnormal returns and subsequently

aggregating these over time and/or securities. Thus, the estimated abnormal return $(AR)_{it}$ of a given security i at time t can be written as

$$\widehat{AR}_{it} = R_{it} - E(R_{it} | X_{it}),$$

where R_{it} represents the actual observed ex-post return and $E(R_{it} | X_{it})$ the ex-ante normal return with X_{it} as the conditioning information of the normal return model (Campbell et al. 1996).

Two predominant normal return estimation models (MacKinlay 1997) are the constant mean return model and the market model, in which X_{it} is the market return that is the same for each security i but changes with t (Campbell et al. 1996). The market model $R_{it} = \alpha_i + \beta_i R_{mt} + \xi_{it}$, linearly relates the return R_{it} of a security i at time t to the return R_{mt} of market portfolio m at time t with disturbance term ξ_{it} that exhibits an expected value of zero and variance $\sigma(\xi_{it})^2$ (MacKinlay 1997). Parameters of the market model are the intercept α_i and the slope β_i of security i , which can be empirically determined by means of OLS regression using estimation window data (MacKinlay 1997).

The abnormal return $(AR)_{it}$ of security i at time t within the event window using the market model can then be estimated as

$$\widehat{AR}_{it} = R_{it} - \hat{\alpha}_i - \hat{\beta}_i R_{mt},$$

where $\hat{\alpha}_i$ and $(\hat{\beta}_i)$ are OLS estimators of the market model.

Event studies typically deal with more than one security and event windows that span over multiple days. Abnormal Returns (AR's) are therefore aggregated to draw overall inferences of the events' impact on returns (MacKinlay 1997), which can be done across time, across securities and both across security and time (Campbell et al. 1996). The cumulative average abnormal return (CAAR) $^{(a,b)}$ of n securities over a time-period within the event window spanning from $t=a$ to b can be written as

$$\widehat{CAAR}(a, b) = \frac{1}{n} \sum_{i=1}^n \sum_{t=a}^b \widehat{AR}_{it}.$$

Empirical research indicates that stock prices are not normally distributed (Brown and Warner 1985). This is typically addressed by using non-parametric tests when analysing abnormal returns of a single day (Kolari and Pynnonen 2011). However, problems arise when non-parametric tests are applied over multiple days on a CAR basis (Cowan 1992, Kolari and Pynnonen 2010). Thus, Kolari and Pynnonen (2011) proposed a Generalized Rank (GRANK) testing procedure which in simulations outperformed previous non-parametric ranks tests and exhibits superior robustness to serial correlation and increased volatility induced by the event as well as cross-sectional correlation of returns due to

event day clustering. Additionally, GRANK often has good or higher empirical power when compared to highly popular parametric tests such as the ordinary t-test or BMP t-test. This holds true for event windows of any given length. Therefore, we rely on GRANK in the following.

3.2 Econometric Design

Table 3 summarizes the econometric design of each event study designed to put research hypotheses sets H1 and H2 to test and are repeated for good and bad news firms. The event of interest is the public announcement of the Heartbleed vulnerability within the cryptographic library OpenSSL on April 7th, 2014. The market model with daily close prices was chosen for estimating the normal returns. First, because gains from more sophisticated multi-factor models such as CAPM and APT based as Fama-French-3-Factor over statistical models are limited (MacKinlay 1997). Second, the market model is slightly less affected by cross-sectional return correlation in the presence of event-date clustering than the Fama-French-3-Factor-Model (Kolari and Pynnonen 2011). The estimation window length to estimate the regression coefficient is 200 trading days, which roughly equals the mean (median) of 52 papers including event studies in IS research originally compiled by Konchitchki and O’Leary (2011). Three different event window lengths, covering 3, 13 and 23 days respectively are applied. The short-horizon event window of three days complies with the econometric reasoning of superiority of short-horizon event windows by Konchitchki and O’Leary (2011). The medium- and long-horizon event windows are designed to capture potential information leakage prior to the event and delayed stock market reaction and act as a robustness check. Inclusion criteria are varying BICS level 1 classifications of firms and data cleaning rules. Missing close price data was replaced by applying Last Observation Carried Forward (LOCF) and subsequently Next Observation Carried Backward (NOCB) for each security with less than or equal to 20 missing observations, which equals 10% of the estimation window length. Daily returns exceeding 100% were replaced by 0% to remove very few outliers.

Price data of all 4,147 stocks in the sample are compiled for the time-period of January 2nd, 2013 to July 21st, 2014. The total number of 1,483,352 HLOC price observations stem from Google Finance (857,447), Bloomberg Professional (527,755), Stooq (84,218) and Quandl (13,012). In addition, daily price data of MSCI World was acquired from Thompson Reuters Datastream. Meta data regarding the vulnerability of each of the 4,147 firms were compiled to assess the potential impact of the Heartbleed vulnerability on affected firms: Heartbleed, as previously shown, affected a multitude of software and hardware solutions: Webservers reached by the Fully Qualified Domain Name (FQDN) were selected as a proxy for a firm’s vulnerability level. FQDNs of 4,137 of the 4,147 firms in the sample could be compiled. The remaining firms did not operate a webserver. Historic scan data from these webservers, allowing for determining each firm’s vulnerability level prior to Heartbleed’s public announcement on April 7th, 2014, originate from Netercraft Ltd. and are aggregated into three categories previously presented in Table 2. In addition, all of the 4,137 available FQDN’s were rescanned on September 1st, 2014 using “Heartbleed-Masstest” written by Al-Bassam (2014).

Table 4: Sample Constituents by Stock Index, Coverage, Focus and Operator

Index	Constituents	Coverage	Region	Operator
Bloomberg European 500	501	Large Cap	Europe	Bloomberg L.P.
CAC 40	40	Large Cap	France	Euronext N.V.
DAX 30	30	Large Cap	Germany	Deutsche Börse AG
EURO STOXX 50	50	Large Cap	Europe	STOXX Ltd.
NASDAQ Composite	2,526	All Cap	U.S.	NASDAQ OMX Group Inc.
Nikkei-225 Stock Average	225	Large Cap	Japan	Nikkei Inc.
S&P 400	400	Mid Cap	U.S.	S&P Dow Jones Indices LLC
S&P 500	501	Large Cap	U.S.	S&P Dow Jones Indices LLC
STOXX Europe 600	600	All Cap	Europe	STOXX Ltd.
Total Constituents	4,147			

Figure 1 depicts the distribution of vulnerability levels within the total constituent sample of 4,147 firms before and after the public announcement of Heartbleed on April 7th, 2014.

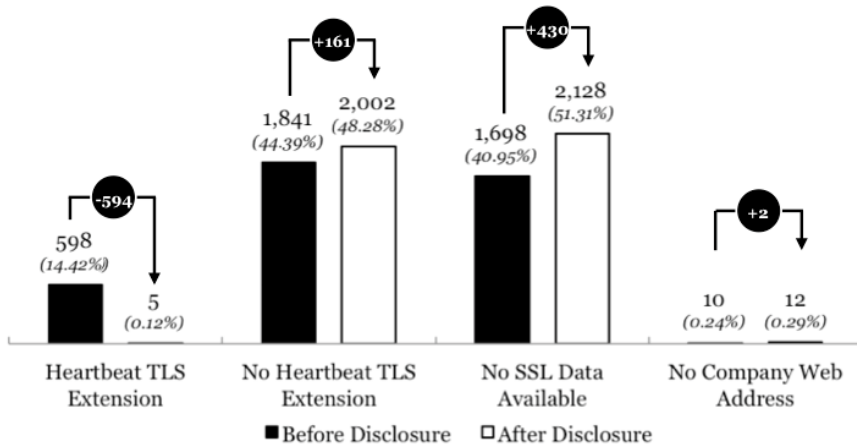


Figure 1: Distribution of Vulnerability Levels within Total Constituent Sample

4.2 Overall Impact (H1)

Hypotheses set H1 is concerned with the overall impact of potential IT security breaches on stock prices of publicly traded firms. Table 5 presents empirical results by providing CAARs and results of two-tailed non-directional GRANK-T tests over short-, medium-, and long-horizon event windows. The null hypothesis tested by the tgrank test statistic states that there is no mean effect while the alternative is that there is a mean effect (Kolari and Pynnonen 2011).

Table 5: Overall Impact of Potential IT Security Breaches on Publicly Traded Firms

Event Study	Group A "Bad News"				Group B "Good News"			
	n	CAAR	t _{grank}	p	n	CAAR	t _{grank}	p
ES1a (<i>Short-Horizon</i>)	538	-1.45%	1.52	0.13	1,647	-1.24%	1.39	0.17
ES2a (<i>Medium-Horizon</i>)	537	-2.94%	1.85	0.07*	1,644	-2.58%	1.81	0.07*
ES3a (<i>Long-Horizon</i>)	536	-5.28%	2.40	0.02**	1,638	-4.30%	2.32	0.02**

Hypothesis H1a predicts a negative stock market reaction in Group A around the public disclosure of potential IT security breaches. There is little empirical support of statistical significance for this prediction in the short-horizon event-window as shown in Table 5. However, in the medium- and long-horizon event windows, the Group A CAARs of -2.94% and -5.28% is of statistical significance at the 10% and 5% level respectively.

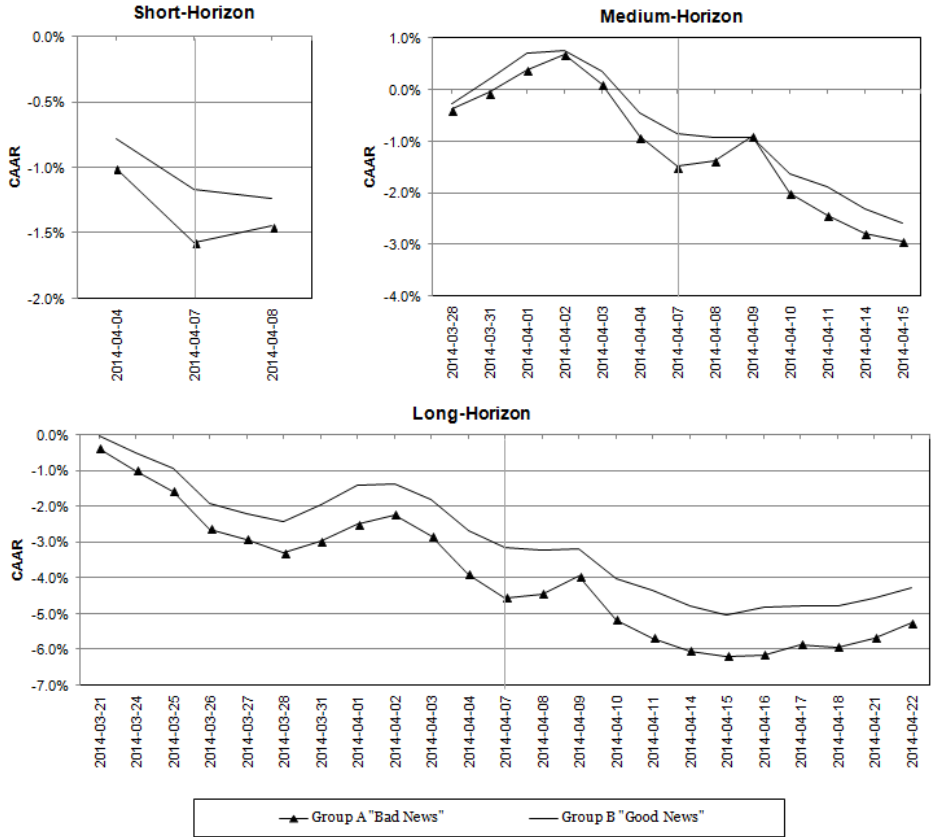


Figure 2: Impact of Potential IT Security Breaches on CAARs

Figure 2 presents the development of the overall impact of Heartbleed within each event-horizon: In the short-horizon event window, Group A firms’ CAAR is most negative at the time of the public announcement of Heartbleed. Looking at the medium-horizon event window length, this recovery of Group A continues until April 9th, 2014, when the CAAR starts to drop even further. The long-horizon event window again shows the two local minima of CAAR in Group A on April 7th and April 15th, 2014 and an additional one around March 28th, 2014. Thus, we observe a time-delayed response of stock markets to potential IT security breaches.

H1b predicts a positive stock market reaction in Group B around the public disclosure of potential IT security breaches. Table 5 reveals that there is little empirical support for this prediction in the short run. The effect on firms’ stock prices in Group B is negative with CAARs of -1.24%, -2.58% and -4.30% in the respective short-, medium and long-horizon event windows. While this effect was of no statistical significance in the first case, it was

in the latter two cases at the 10% and 5% level. However, Figure 2 reveals that firms in the Group B performed better, relative to firms in Group A.

4.3 Industry Specific Differences (H2)

H2a predicts the existence of industry specific differences in negative stock market reaction of firms within Group A around public disclosure of potential IT security breaches. Results presented in Table 6 seem to support this prediction. Most industry specific CAARs in the short-horizon event window are of no statistical significance according to the two-tailed GRANK-T test. However, firms operating in the Consumer Discretionary and Health Care industry experienced CAARs of -1.43 and -2.59%, which are significant at the 10% and 5% level, respectively. Interestingly, when looking at the results of the medium-horizon event window, the statistical significance of the effect on firms in the Consumer Discretionary sector vanishes. Instead, the CAAR of -4.9% of firms in the Communication sector becomes statistically significant at the 1% level. In addition, the effect on the Health Care industry becomes significant at the 1% level with a CAAR of -6.55%. In the long-horizon event window, eight out of ten industries experienced an effect of statistical significance at the 10% level ranging from CAARs of -9.47% to +4.4%.

H2b predicts the existence of industry specific differences in positive stock market reaction of firms within Group B around public disclosure of potential IT security breaches: Table 6 indicates that there is little support for this prediction in the short-horizon event window, as only the CAAR of -1.40% in the Consumer Discretionary sector is of statistical significance. Additionally, there is little support for the predicted positive effect as the vast majority of industry specific CAARs is negative. In the medium-horizon event window, three industries experienced a significant effect with CAARs ranging from -3.14 (Communications), over 3.91% (Technology) to -8.82% (Health Care). In the long-horizon event window, these negative effects increases even more. In addition, the negative effects within the Consumer Discretionary and Financials sectors are statistical significance.

Table 6: Industry Specific Impact of Potential IT Security Breaches on Stock Prices

ID	Industry	Group A				Group B			
		n	CAAR	t _{grank}	p	n	CAAR	t _{grank}	p
<i>Short-Horizon Event Window:</i>									
ES1a	All Industries	538	-1.45%	1.520	0.1302	1647	-1.24%	1.389	0.1665
ES1b	Communications	47	-1.91%	1.411	0.1598	101	-1.57%	1.444	0.1503
ES1c	Consumer Discretionary	129	-1.43%	1.717	0.0876*	231	-1.40%	2.043	0.0424**
ES1d	Consumer Staples	28	-2.04%	1.415	0.1587	104	0.21%	0.314	0.7536
ES1e	Energy	20	-0.02%	0.677	0.4991	76	-1.13%	0.420	0.6751
ES1f	Financials	78	-1.17%	0.901	0.3685	404	-1.00%	1.148	0.2525
ES1g	Health Care	66	-2.59%	2.237	0.0264**	173	-2.56%	1.123	0.2627
ES1h	Industrials	39	-0.88%	0.935	0.3511	182	-1.09%	1.385	0.1677
ES1i	Materials	17	-0.48%	0.443	0.6584	96	-0.34%	0.051	0.9593
ES1j	Technology	112	-1.27%	1.389	0.1663	225	-2.07%	1.582	0.1153
ES1k	Utilities	2	-0.35%	0.225	0.8220	55	0.88%	0.934	0.3513
<i>Medium-Horizon Event Window:</i>									
ES2a	All Industries	537	-2.94%	1.850	0.0658*	1644	-2.58%	1.809	0.0719*
ES2b	Communications	47	-4.90%	3.037	0.0027***	101	-3.14%	2.472	0.0143**
ES2c	Consumer Discretionary	129	-2.15%	1.346	0.1799	231	-2.26%	1.614	0.1081
ES2d	Consumer Staples	28	-2.40%	0.105	0.9164	104	-0.24%	0.106	0.9155
ES2e	Energy	20	2.30%	1.561	0.1200	76	0.75%	1.176	0.2412
ES2f	Financials	78	-1.88%	1.434	0.1531	403	-1.90%	1.354	0.1772
ES2g	Health Care	66	-6.55%	2.978	0.0033***	172	-8.82%	3.641	0.0003***
ES2h	Industrials	39	-0.96%	0.515	0.6075	181	-2.00%	1.162	0.2467
ES2i	Materials	17	-0.76%	0.626	0.5319	96	0.39%	0.307	0.7592
ES2j	Technology	111	-3.74%	1.638	0.1030	225	-3.91%	2.118	0.0354**
ES2k	Utilities	2	-2.26%	0.500	0.6177	55	0.89%	0.472	0.6372
<i>Long-Horizon Event Window:</i>									
ES3a	All Industries	536	-5.28%	2.399	0.0174**	1638	-4.30%	2.320	0.0214**
ES3b	Communications	47	-7.90%	2.632	0.0091***	101	-5.85%	3.028	0.0028***
ES3c	Consumer Discretionary	129	-4.40%	1.982	0.0488**	231	-4.27%	2.126	0.0347**
ES3d	Consumer Staples	28	-3.98%	1.269	0.2059	103	0.33%	1.170	0.2433
ES3e	Energy	20	4.40%	1.908	0.0579*	76	-0.67%	0.888	0.3757
ES3f	Financials	78	-3.74%	1.902	0.0586*	400	-4.42%	2.272	0.0242**
ES3g	Health Care	66	-9.47%	3.088	0.0023***	172	-11.16%	3.924	0.0001***
ES3h	Industrials	38	-1.74%	0.259	0.7962	179	-2.56%	1.402	0.1623
ES3i	Materials	17	-3.82%	1.940	0.0538*	96	1.95%	1.369	0.1724
ES3j	Technology	111	-7.44%	2.504	0.0131**	225	-6.88%	2.947	0.0036***
ES3k	Utilities	2	3.65%	2.628	0.0092***	55	1.12%	0.619	0.5369

Limitations of this work are primarily related to the underlying event study methodology. These can be divided into problems related to theoretical assumptions and research design (McWilliams and Siegel 1997). Theoretical assumptions are (1) efficient markets, (2) no-anticipation of the event examined and (3) the absence of confounding events

(McWilliams and Siegel 1997). First, regarding the efficient markets assumption, we assumed that people are both able to find and make sense of publicly available information. While easy to find, it is possible that firm stakeholders were unable to make sense of it due to the technical sophistication of the Heartbleed vulnerability. Thus, even if large investors were aware of the problem, they may have concluded that other stakeholders were not and assumed no re-evaluation of the risk of unintentional disclosure of private information would take place. Second, event anticipation is unlikely as search query data of Google and Wikipedia revealed no interest in Heartbleed prior its public disclosure. Third, it is not possible to control for confounding events when analyzing a sample of 4,147 firms. However, effects are likely to be wiped out due to the large sample size and are especially unlikely in the short-horizon event window where the economic calendar provided by ECONODAY reveals no event window contaminating news. Typical additional issues of event studies are the sample size, the identification of outliers, the length and justification of the event window and further explanation of abnormal returns (McWilliams and Siegel 1997). Because of the large data sample, explicitly defined outlier return thresholds, theoretically justified event windows and research hypotheses, these should not pose a significant issue. Next to these limitations, future confirmatory studies must examine comparable large scale IT security issues where a multitude of firms are affected.

5 Conclusion and Outlook

This paper provides empirical evidence on the global impact of potential IT security breaches on stock markets. Thereby, it enhances the understanding of the full economic impact of information privacy measures by shedding light on previously neglected hidden costs. By drawing on IBT, research hypotheses are developed and put to test by means of multiple large scale event studies covering 4,147 firms headquartered in 43 countries.

First, our exploratory study indicates that stock markets react with a time delay to potential IT security breaches. Second, we provide evidence for a discrimination of firms operating in different industries. Therefore, this work extends the understanding of consequences of jeopardized IT security by adding a previously neglected hidden cost component to information privacy considerations. Future scientific research in this field could investigate additional determinants of the discrimination of stock markets between potential and actual IT security breaches.

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Coworking from the Company's Perspective - Serendipity-biotope or Getaway-spot?

BARBARA JOSEF

Abstract The phenomenon coworking has been around since 2005. While the initial drivers and beneficiaries were microbusinesses and freelancers, corporations have recently started to develop interest in the topic. Not because they see in coworking spaces a candidate to substitute their corporate office with, but because they are interested in the opportunities it offers in addition to the primary and secondary (home office) work location – be it from an innovation management or employee wellbeing standpoint. A pilot project with two Swiss ICT companies analysed the coworking movement from the perspective of corporations and identified value propositions as well as obstacles. Based on the different needs and behaviours of the experiment participants, four personae were identified. The study showed that although utilization by the pilot participants was on a very low level, the signal for change of the organizational culture is an interesting side effect of introducing coworking as an alternative work scenario.

Keywords: •Coworking • Virtual Collaboration • Remote Work •
Boundary Management •

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1 Introduction

The emergence of new technologies has changed the nature of work since the early 1980s in two ways. Firstly, the ongoing transformation has an impact on work relations and lead to an increase in nonstandard work arrangements (Kalleberg 2000). Secondly, even within standard work relations, the organization of work is undergoing a significant change, resulting in new ways of collaborating with stakeholder groups inside and outside of organizations. Although the changed nature of work relations is the driver for the phenomena coworking, the focus of this paper is not on the rise of the freelance or gig economy, but on the question how traditional organizations deal with the new work scenario coworking and how they integrate it in the portfolio of existing ones. It is thereby of particular interest, in which ways their usage scenarios are different from the ones of freelancers and microbusinesses and how the collision of the two entities in these third places (Oldenburg 1989) could be beneficial for both. Since coworking is a rather new phenomenon it is not yet elaborately discussed in the academic literature; this is even more the case for coworking from a company’s perspective, where only few articles exist, e.g. Ross & Ressler (2015) who look at coworking as an alternative for “home-based telework” in the public and private sector. The focus of this article is however not on the potential for replacing a work scenario, but on adding it to existing ones.

1.1 The changing nature of work

Remote work scenarios are not new - it was the first oil crises in 1973 that helped telework and telecommuting to its triumph (Bailey & Kurland 2002; Nilles 1975). However, today’s highly mobile and connected digital nomads have little in common with these early teleworkers, who completed work outside of the office in an isolated manner, supported by stationary computers, fixed telephones and fax machines (Makimoto & Manners 1997, Messenger & Gschwind 2016). The emergence of mobile devices, cloud computing as well as social software is drastically transforming the way in which companies conduct work and organize collaboration (see also Eagle 2004). Today, work is no longer tied to a time or place which makes the assignment of all employees to a fixed space obsolete (Spreitzer, Garrett & Bacevice 2015).

1.2 The emergence of coworking

When Brad Neuberg¹ coined the term coworking in 2005 in San Francisco (Spinuzzi 2012) he can’t have foreseen to which significant movement he acted as midwife; at least when it comes to the naming of this new phenomena encompassing the disentanglement of time and space for knowledge work. Looking at coworking from a broader perspective, it has become the symbol for an economy, where non-standard forms of work (an extensive overview of these forms is provided by Capelli & Keller 2013), as alternatives to traditional full time-employments mushroom and force management as well as social

science to rethink existing models and assumptions. The focus of this article is however not on new forms of employment – which have beyond doubt been the catalyst of the whole coworking movement – but the question, which value proposition coworking offers from the perspective of established firms. While “working alone together” (Spinuzzi 2012) is one of the main promises for freelancers and microbusiness, coworking spaces only represent an alternative work scenario for established firms, at least in a short-term view. The relevant question from their standpoint is therefore how these third places (Oldenburg 1989; Gandini 2015) will complement the existing work scenarios – in contrast to freelancers and microbusinesses, who chose coworking as primary work location. These user groups have been subject to various studies in the last decade (Spinuzzi 2012, Capdevia 2013, Moriset 2013). The key question to expand the existing studies on coworking is therefore “what is it for whom?”.

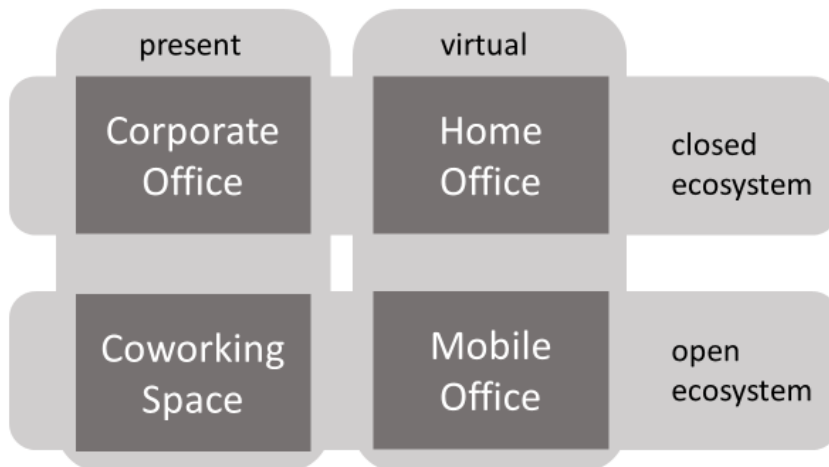


Figure 2: Work Scenarios from a Company’s Perspective (Amstutz & Schwehr 2014; Ross & Ressia 2015)

1.3 Definitions of Coworking

As coworking is only since recently discussed in the academic literature, various definitions coexist. The most cited one is the one captured in the Coworking Wiki²: “...independent professionals and those with workplace flexibility work better together than they do alone. Coworking spaces are about community-building and sustainability. Participants agree to uphold the values set forth by the movement’s founders, as well as interact and share with one another. We are about creating better places to work and as a result, a better way to work.” This definition is based on the five values described in the Coworking Manifesto.

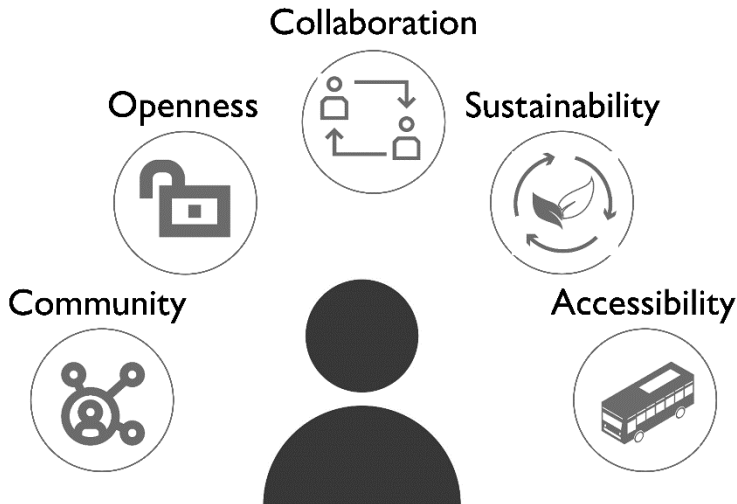


Figure 3: Coworking Values according to the Coworking Manifesto³

As this definition focuses strongly on ideologic goals, the definition has limited validity from a company's perspective. Based on the accurate overview of the most important aspects of coworking provided by Bouncken and Reuschl (2016) the following own definition shall be used in this article:

“Coworking spaces are neutral places, where affiliated and unaffiliated professionals work side by side or in collaboration. The spaces are used by individuals, teams or other cross-organizational groups, during a specific project phase or for an unlimited period, in addition to other work scenarios or exclusively.”

The most significant difference between coworking as envisaged by freelancers and microbusinesses in the early years and companies, who only started developing interest recently, is the community aspect. Whereas participating in an active diverse community is for most companies an important benefit, it is not an exclusion criterion. As the present field experiment suggests, coworking also offers attractive opportunities from a boundary management perspective, where the benefit of individual flexibility is more important than mingling with others and fostering “accelerated serendipity” (Chris Messinas, Co-Founder Citizen Space quoted in Moriset 2013).

Coworking is far more than a hype, as a look at the growth rate since 2005 confirms. According to Deskmag (2017), both the number of coworking spaces and members continue to grow rapidly; by the end of 2016, 11 300 Coworking Spaces and 835 000 coworking members were counted worldwide, thereof 70 in Switzerland, where the experiment took place. Not included in these numbers are coworking spaces and seats offered by companies – it can be expected that the number of corporate powered workspaces (Schürmann 2013) will also rapidly increase, as can for example be seen in

Switzerland with the Büro Züri⁴ powered by ZKB, the Welle 7⁵ from Migros, the BusinessPoint⁶ from Witzig the Office Company or the public Coworking Space of Microsoft Switzerland⁷. Although these offers look at a first glance similar, it's important to distinguish between companies, who offer coworking as part of their product range in separate locations and those, who open up their own workspaces to a wider community (Kojo & Nenonen 2016) with the goal to foster new ways of interacting within their ecosystem.

Summarized, companies interested in coworking have the following options available:

1. **Coworking as an alternative work scenario:** Companies offer their employees coworking as an additional work scenario, complementing the corporate office, home office and mobile work.
2. **Replacement for the corporate office:** Companies refrain from operating their own offices, e.g. for a subsidiary in a specific region, and use a coworking spaces as an office.
3. **Coworking as a new offer:** Companies offer coworking as part of their product range and/or open their own workspace for collaboration with externals.

2 Research Methodology

This research was undertaken with two main goals. The first was to understand the value proposition that coworking offers from the perspective of companies who operate corporate offices, but are interested in alternative work scenarios in addition to the existing ones. The second was to identify different usage scenarios and based on these to derive insights, how companies can integrate this new work scenario in the existing ones. Research was done in an exploratory way, as both the subject coworking and in particular the perspective of established companies is relatively new in the academic literature and not all relevant aspects are yet discovered (Stebbins 2001). In-depth, semi-structured, qualitative research interviews were conducted. This methodology was chosen as the focus was on understanding the new scenario from the point of view of the participants of the field experiment.

2.1 Study participants

The basis for this study is a field experiment, in which voluntary participants of two Swiss ICT companies, 9 from the smaller (a local subsidiary from a global corporation) and 16 from the bigger one (headquartered in Switzerland), took place. During 4 months the 25 volunteers were asked to try out coworking. No specifications were made regarding the expected frequency of usage, the combination with existing work scenarios or the visited coworking spaces; they could choose from over 100 coworking locations within Switzerland⁸. The participants were informed about the project via social intranet, email, face-to-face discussions with their managers and an optional kick-off event. As all participants volunteered, the group was very heterogenous and consisted of members

from different teams and with different job profiles; most of them were in marketing or sales roles. All participants came from a company and team culture where it was normal and accepted that work was also done outside of the corporate office or the client's facility. Except for two participants all were employed with a fulltime contract. They varied quite strongly in their degree of mobility – about half of them (11) still had their personal desk, the others worked with a shared desk concept with (11) or without (3) a clearly assigned home base. Some of them had already been in coworking spaces (workshops, meetings, visits) but no participant was experienced with coworking. As the boundaries between mobile knowledge workers and more stationary knowledge workers are blurring (Jarrahi & Thomson 2016), no further distinction regarding degree of mobility was made. During the four months field experiment a few interventions were made (reminders via social intranet and email or personal by line manager) as the utilization of the coworking spaces was on a very low level from the beginning. The interviews were done at the end of the experiment.

2.2 Data collection

The study is a qualitative inquiry based on semistructured interviews with 25 participants of a coworking field experiment. The interviews were mostly done in person in meeting rooms provided by the respective employer, a few were done via Skype. Prior to the interview, the interviewer briefly explained the most relevant facts about the field experiment and the focus of the study. This information was already provided in written beforehand in the process of recruiting the voluntary participants. The interviews were audio recorded and transcribed; they ranged in length from 40 to 65 minutes and were conducted in German or English. The interview protocol was open-ended with the goal, to get a detailed understanding of the person's work disposition (standard workstyle, work arrangement, role, work preferences, strategies for dealing with mobility, use of technology etc.) as well as of their experiences with the new work scenario coworking.

2.3 Data analyses

Data analyses was done based on the exploratory grounded approach chosen as methodology for this study. The audio recordings of the interviews were transcribed, imported in to ATLAS.ti and coded in an open way. Based on the first interviews the interview guidance was slightly adapted, however after 15 interviews a certain saturation could be remarked, where no new themes related to the core focus came up. The usage scenarios, personae, and recommendations were done based on the interviews and an extensive literature research on coworking and new work scenarios from the perspective of companies.

3 Findings

The findings are presented as follows: first the insights into factors that were analysed by means of the semi-structured interviews are presented in the form of a general evaluation.

It is then followed by the identified benefits and obstacles of coworking from the perspective of companies, which is derived from the interviews in combination with literature research.

3.1 General Evaluation

- **Utilization:** The most surprising finding of the coworking experiment was the low utilization figures. On average the participants went 2.9 times in the coworking spaces within the four months and spent 3.6 hours per visit there. It can be expected that the utilization would have been on an even lower level without the interventions which reminded the participant of the project. Whether the low utilization was based on the short experiment duration, the low eagerness to experiment or the schedules of the participants, which did not allow for more time spend in coworking spaces, was not inquired.
- **Perception of the experiment:** Despite the low utilization, the general feedback of the participants towards the project was throughout positive. Most of them interpreted the pilot project as a sign, that their employer not only tolerated working outside of the office (for example in the home office, where cost savings might be a motivation for the employer) but also invested in new ways of working.
- **Individual productivity:** A small majority (12 vs. 9) stated that they were more productive in the corporate office compared to the coworking spaces. It is noteworthy that most of the participants who said they were most productive in the coworking space, do not like to work from home. It might be interesting to do further research on the question, in which ways the personal boundary management strategies (Gisin, Schulze & Degenhardt 2016) and the individual coworking use cases are interlinked. Since all participants used the coworking spaces for individual work and not for team collaboration, only the individual productivity could be observed. The results of the study might be different if whole teams use (the same) coworking space.
- **Individual creativity:** The participants rated the corporate office followed by the home office as the location where they were most creative, coworking only ranked as third. Given that coworking spaces are often referred to as creative hubs, at least from the perspective of freelancers and microbusinesses, it was surprising to see that the corporate workers did not choose them as preferred location for creative work. Nonetheless mentioned a small majority when asked that they had gained new impulses in the coworking spaces - be it by meeting new people or stumbling across new ideas. Some interviewees attributed the lower creativity to the fact, that they did not have whiteboards, flipcharts or other or other visualization tools available in the coworking space or they did not want to transport them after use to continue working with them.
- **Use of technology:** All interviewees stated that they used the same communication and collaboration technologies as they use in the corporate office, at home or when working mobile. What was different was the amount of

time they spent in calls compared to the corporate office. A lot of participant went to the coworking spaces especially to make calls or to conduct virtual meetings – this was in particular the case, when they were traveling the whole day and tried to use time in-between external meetings in a productive and way. This usage scenario – coworking as a “filler” for productivity - conflicts with the original purpose and focus of most coworking spaces, which is to bring people together and not to foster undisturbed work and retreat. Besides the disturbance by noise or the fear of disturbing others when doing a call in the open space zone, the participants raised concerns regarding data privacy and protection.

- **Online and offline community management:** Belonging to an active community is one of the main reasons for freelancers and microbusinesses to engage in coworking. One aspect of the interview was therefore, whether this element was also looked for by the participants of the experiment. When asked about contacts with other coworkers in the space, the majority reported that they were hardly any exchanges with others. although most of them did not actively look for new encounters, they saw in networking and informal exchanges with new contacts a big advantage of coworking compared to other work scenarios. Some interviewees mentioned, that they would plan their coworking journey differently in the future, e.g. having lunch with the community, participating in local events or blocking time for informal discussions instead of spending the whole day in virtual meetings or working rigidly through their task lists. Most participants were in contact with the coworking host for the check-in procedure; however, they did not notice any community management measures (Capdevila 2013; Spreitzer, Garret, Bacevice 2015), such as an active introduction to other members.

Professional Coworking chains such as WeWork offer also a virtual community management platform, which is mainly used to communicate with the members or to facilitate the exchange between the members. The project team in charge of the field experiment set up a group on the enterprise social platform Yammer, which could be accessed by employees of both participating companies. The goal of using an enterprise social network was to facilitate the project coordination between the project leads and the participants, but also to enable networking amongst the participants, for example to coordinate physical meetings in the coworking spaces. Despite the users' familiarity with enterprise social networking, the group did not attract any interest from the participants and was not used except by the project leads to share background information about the experiment in the beginning.

3.2 Benefits and Obstacles

The following table aims at summarizing the gained insights by listing the most important benefits of coworking as well as the perceived obstacles from the point of view of

established companies, who look at coworking as an additional work scenario complementing the existing ones.

Table 1: Summary of Findings, References and Mitigation

Benefits of Coworking	Relevance	References
Signal for change and trust	A lot of companies are experienced with remote work and do already grant their knowledge workers a certain flexibility regarding time and place, which can be interpreted as a signal of trust. In the interviews the argument was brought up, that the signal for change and an output oriented innovation culture was much more convincing in the case of coworking, because it was a conscious investment in the work culture. Many employees suspect that their employers’ tolerance for home office is motivated by potential infrastructure savings in the corporate office. Coworking is therefore a much stronger signal than just allowing remote work.	Weibel et. al. 2016; Messenger & Gschwind 2016; de Kok 2016; Leclercq-Vandelannoitte & Isaac 2016; Nicklin, Cerasoli & Dydyn 2016; de Leede & Kraijenbrink 2014
Networking, serendipity and knowledge exchange	Although the interviewees were not deeply involved in the exchange with the local community, the aspect of knowledge exchange and networking with external stakeholders is interesting from an innovation management (serendipitous encounters, open innovation process), diversity (different backgrounds & experiences) and marketing (access to new target groups) perspective.	De Kok 2016; Simula & Ahola 2014; Parrino 2015; Nonaka 1994 ; Anand & Singh 2011; Eagle 2004
Flexibility and efficiency	From the individual worker’s perspective, coworking helps to increase the personal efficiency; it offers spatial flexibility which helps to cope with mobility (e.g. participating in virtual meetings while traveling). From the company’s perspective, an interesting scenario is to temporarily outsource certain activities, phases of projects or teams to coworking locations, which in	Spreitzer, Garrett & Bacevice 2015; Johns & Gratton 2013

	turn helps them, to balance infrastructure costs, as the corporate office does not need to cover for very spatial needs that diverge from the norm.	
Boundary management	Knowledge workers differ in their boundary tactics, with work-life integration and separation at the two extreme poles. The findings in the study suggest that the two types see different usage scenarios in coworking. For separators, who do not want to work from home, coworking is an interesting option to practice flexibility and safe commuting time without mingling work and private life.	Ashforth, Kreiner & Fugate 2000; Nippert-Eng 1996; Gisin, Schulze & Degenhardt 2016
Obstacles of Coworking	Relevance	Mitigation
Possibility of retreat	The interviewees were missing separate spaces for calls and virtual meetings. Because of their spatial separation from internal and external stakeholders, this is an obvious need; however it showed at the same time, that most of them did not adapt their behaviour and work schedule to the new space concept during the observed phase.	Coworking spaces should increase their repertoire of work scenarios, in particular with regard to rooms for retreat, if they want to be more attractive for corporate coworkers. To gain a maximal benefit of this new space concept, it is important that coworkers also reflect their work behaviour and prioritize other, more creative and collaborative activities in the coworking spaces.
Data protection & privacy	A lot of interviewees were insecure about the correct handling of delicate data and information in coworking spaces, for example if they had to take their laptops with them during breaks or if they could sit next to strangers while reading confidential emails. Even if	It's important that the employees are fully aware of data sensitivity and confidentiality classifications. Privacy shields for the

	rooms for confidential phone calls are available, the insecurity remains, as these settings are not always soundproof.	screen might already help; room dividers are effective too, but against the principle of openness lived by most coworking spaces.
Coordination within organization and team	Despite the positive attitude towards the new work scenario, a lot of interviewees mentioned their fear of increased coordination efforts within the team and the organization. Some of them mentioned, that complexity was already high because one fraction of the team was always traveling or working from home. This concern raised the question, whether the reduced face time for formal and informal interactions within the organization would not lead to a decrease of team productivity, connectedness and identification with the organization.	The introduction of new work formats should be well accompanied by corresponding measures and team discussions. Team chats and enterprise social platforms can support the coordination.
Equipment of space and workplaces	Whereas about half of the experiment participants expected to have the same equipment available in the coworking space as in the corporate office (monitor, ergonomic furniture, flipcharts etc.) the other half was indifferent; most appreciated the variety and “used what was there”.	Coworking spaces should actively communicate about their equipment to facilitate the selection of the right space.

Other important success factors mentioned by many interviewees as important requirements were the network quality and ease of access, a simple booking and billing process for the coworking hours consumed (most stated clearly that the billing should be done via the corporation directly and not via expense management), the geographical location and the proximity to public transportation as well as good quality of coffee. As these factors do not differ from the needs of freelancers and microbusinesses they were not in the focus of the study.

3.3 Coworking Personae

Based on the interviews and literature research, the study author tried to identify different poles of usage and expectations and grouped them into different personae. The goal of the personae is not to identify a distinct behavior, but to visualize the different needs which in turn allows to build different coworking journeys. The personae might also be

helpful when it comes to discussing different situational preferences and spatial needs in the corporate office. A similar attempt to classify the different users was done by Bilandzic & Foth (2013), who distinguish in their studies about coworking in libraries between those who use coworking-spaces mainly because of the offered infrastructure, learners who use coworking-spaces to acquire knowledge and have an exchange with peers, and socializers who search for recognition and acknowledgement.

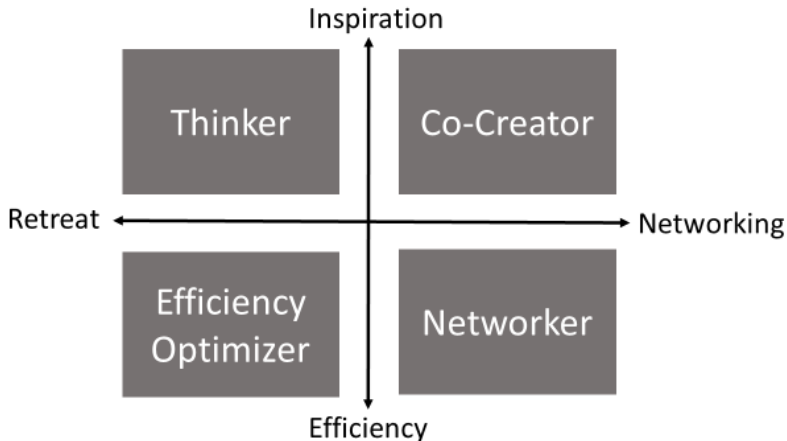


Figure 3: Coworking Personae

As Figure 3 shows, the interviewees diverged most regarding the two following axes:

- Connectedness: are coworking spaces primarily used to get access to a (different) community or to dissociate from the team/office or family/home?
- Disposition: are coworking spaces primarily used to get inspiration from the different space and community or with the goal to increase of efficiency, e.g. bridging time between meetings.

4 Discussion

The duration of the observed experiment was a rather short period when it comes to analyzing the acceptance and embedding of this new work scenario into existing ones. It is above all too short to observe the changed behavior based on new interpretations of coworking, which in turn will also lead to new interpretations of the corporate office, home office and mobile work. Orlikowski’s (2008) practice lens addresses changes in technology use over time, where users “may, deliberately or inadvertently, use it in ways not anticipated by the developers”. These new interpretations lead to new work practices – and as these work practices change, interpretations of the technology’s function change too (Leonardi, Treem & Jackson 2010). It would therefore be interesting to observe and discuss these multiple interpretations and associated changes in work practices over a

longer period. One of these new interpretations was the reason for the title of the study: whereas the experiment leads and study author would have expected, that participants were most interested in new serendipitous encounters, several felt like one participant who stated: "I like coworking. It gives me a rest from my superior and my family." Addressing these different expectations and perceptions and dealing with the multiple interpretations over time as mentioned is an important management aspect – when companies want to benefit from new work practices, they also need to assume responsibility for the organizational learning process. One concrete example is to address whether it makes sense to go to a coworking space when the agenda is fully booked with calls and virtual meetings.

The measured utilization figures are also an interesting point of discussion. Whether they were so low, because the pilot duration was too short or because the participants schedules did not allow much time for experimentation or if they preferred working from home or on the road instead of discovering new scenarios is unclear. The conclusion, that they were not interested in coworking or that it offers no value to companies falls short also with regard to the very positive reactions they expressed in the interviews.

5 Conclusion

The biggest consensus amongst all study participant was reached with the question, whether they would like to trade in their corporate office for coworking. None of the interviewees opted for this scenario; most of them mentioned the importance of their office as center of gravity and/or identification. Part of this reaction can be explained, that they were scattered to over 100 locations and participated as individuals, not as teams in the pilot project.

One element which came out clearly in the study is that networking, serendipitous encounters and informal knowledge exchange with other members do not come for free in coworking spaces – it needs concrete measures if these benefits are the main motivation for companies to invest in coworking. These findings are in line with other research, e.g. Parrino (2015) who showed in two case studies that co-location does not automatically lead to interactions and knowledge exchange between individuals. Both the focus of the coworking space (community versus business service etc.) as well as the policies that promote interactions amongst members are decisive factors that determine whether interaction and knowledge exchange takes place (Parrino 2015). Similar findings are presented by Spinuzzi (2012) who differentiates between "good neighbours" and "good partners", depending on whether people just work side by side on their own projects or collaborate in a more intense way.

The interviews also highlighted the relevance of the work and leadership culture for the successful adoption of new work scenarios. As Posseriede & Plantenga (2014) demonstrated, both schedule and location flexibility have a positive impact on job satisfaction. However only schedule flexibility has a positive impact on work-life

balance; location flexibility has a neutral impact. It is therefore important, that coworking is not only seen as an attractive additional work location, but that also a certain autonomy to plan the work schedule is granted.

Coworking is not only interesting as a new work scenario outside of the corporate office. Many learnings can also be used for the redesign of the corporate offices and the collaboration culture or as Spreitzer, Bacevice & Garrett (2015) comment the current transformation of many corporate offices: "the company is reverse-engineering its office into a coworking space."

Notes

1 see also http://codinginparadise.org/ebooks/html/blog/start_of_coworking.html

2 <http://wiki.coworking.org/w/page/16583831/FrontPage>

3 <http://coworkingmanifesto.com/>

4 www.buero-zueri.ch

5 www.welle7.ch

6 www.witzig.ch/de/find/businesspoint

7 <https://blog.hslu.ch/crealab/2016/11/30/wie-innovationsfaehigkeit-und-unternehmenskultur-zusammenspielen/>

8 By the end of 2016, Coworking Switzerland counted 70 Coworking Spaces. The facilitator of this project, the Swiss booking platform Popupoffice.ch, offers over 100 locations, since also spaces that do not fall under the definition of coworking in a narrow sense are included (e.g. single desk in PR agency).

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Wellness Technology Use in Everyday Life: A Diary Study

TUOMAS KARI, Eeva KETTUNEN, PANU MOILANEN & LAURI FRANK

Abstract Digital wellness technologies and their use have become exceedingly popular. More and more people are using them in their everyday lives. Respectively, the need to understand their users and usage has increased. This study aims to deepen the understanding of how people use and perceive wellness technologies in their everyday lives. Empirically, the study is based on diaries collected from 18 participants over a six-week period, which are analysed using thematic analysis. The results show that the use of wellness technologies can positively influence wellness motivation. Further, they can help people to learn more about their own wellness related behaviour and its effects (learning-effect). Experience of gamification can influence motivation positively. It also seems that some people engage in self-gamification, which is defined in this study as a desire-based action to gamify some recurring activities or bodily functions.

Keywords: • Digital Wellness • Wellness Technology • Sports Technology
• Gamification • Self-gamification • Diary Study • eHealth •

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1 Introduction

During the past years, individuals and healthcare sector have become increasingly interested in measuring and promoting various aspects of wellness and health by using different technological solutions. Although different technological solutions for personal wellness have been around for quite a while, the whole business field of wellness technology is still at a relatively immature stage and rapidly growing (Grand View Research, 2016; Welltodo, 2016). There is a wide variety of products ranging from exercise and wellness applications to activity trackers and versatile sport watches in the market, and completely new solutions are released constantly. Typical to these devices is that they can be used for self-tracking purposes (Kari et al., 2016a). The findings of Miyamoto et al. (2016) suggest that tracking wellness related data alone may result in heightened awareness of daily activity, but it may not be adequate to sustain the use of wellness technologies, which often have low retention rates. Wang et al. (2016) found that a wellness application is more effective the more frequently it is used, and more effective when used over a longer period of time compared to short-term use. Such reports and findings demonstrate the growing need for studying the usage of these technologies.

Regardless of the business field, it is essential to understand as much as possible about the target audience. Studying consumers' motives and habits is important to deepen the understanding about their desires and needs. There exists a wide variety of user characteristics within the wellness technology users, and different target groups have different set of requirements (Warrich, 2016). As wellness technologies are ever more used, there is a growing need to deepen the understanding on their users and thus, it is important to research them to gain new understanding on this matter.

The purpose of this study is to deepen the understanding of how people use and perceive wellness technology in their everyday lives. Besides the many aspects regarding wellness technology use itself, the focus of the study is also on how wellness technology gamification is perceived and whether it motivates people in their wellness related activities. Third point of interest is how people think integrating wellness technologies into their lives is seen by other people, and how these thoughts might influence their wellness technology usage in general. The main research questions studied in this paper are:

- 1) What kinds of feelings do wellness technologies and their use wake among their users?
- 2) How do people experience gamification with wellness technology and how does technology support gamifying?
- 3) How do people perceive other people's views on their wellness technology usage and gamification?

The term wellness technology is used as an overall term for different kinds of technological health, wellness, and sports related solutions that people use in their

everyday lives. Such solutions include e.g. devices, applications, and services. The study follows a qualitative approach and the empirical analysis is based on diaries collected from 18 participants over a six-week period.

The results of this study can help the wellness technology providers in deepening their understanding on wellness technology usage and in providing solutions that are better welcomed by their target audiences. The findings may also assist people working in the healthcare sector in implementing different wellness technologies for health and wellness related purposes.

The paper comprises of six sections: introduction, theoretical background, methodology, results, conclusion, and finally the limitations and future research section.

2 Theoretical Background

2.1 Motivation and Wellness Technology

The actions and behaviours of individuals are influenced by observations on how other people act. According to Bandura's social cognitive theory, observational learning and social experience play an important role in people's personality development and in the development of their self-efficacy (Bandura, 1989). Self-efficacy refers to one's own belief in one's own capability to do a task, which in turn affects their motivation to attempt that task. People with high self-efficacy feel a task more attainable and less difficult and trust their abilities to perform it, whereas people with low self-efficacy might perceive a task as too difficult and may be less motivated to perform it (Bandura, 1998).

According to Ryan and Deci (2000), motivation can be divided into intrinsic and extrinsic motivation. Intrinsically motivated people perform activities such as exercising just because of the pleasure of doing it, whereas more extrinsically motivated people do the activity because they see it as a tool of gaining something else they are interested in, such as competition prizes from a race or acceptance from their peers. A person who does not have any motivation to perform a task is considered amotivated.

There has been a substantial interest in the role of wellness technology to motivate people to be more physically active or to adhere to physical activity guidelines (see e.g. Marcus, Ciccolo & Sciamanna, 2008). In this kind of research, wellness technology is assessed especially from the points of view of various models of behavioural change – especially the transtheoretical model by Prochaska and DiClemente (2015) – or motivational psychology. Results concerning the role of wellness technology are somewhat contradictory. According to a systematic review by Sjögren et al. (2013), one cannot be certain that technology contributes to adherence in intervention studies, but the role of technology should be researched further. However, if technology-based interventions (including exergaming) are used in rehabilitation, wellness technology seems to increase the physical activity of intervention participants (Rintala et al., 2016). This is interesting,

as this research finding suggests that the main motivation for the increase has to be based on personal and intrinsic motivation and it can be strengthened with technology.

The reasons why different kinds of wellness technologies are acquired seem to vary. Previous research has shown that the usage intentions of different solutions can be driven by both utilitarian or hedonic perceptions (e.g. Kari & Makkonen, 2014; Makkonen et al., 2012a; Makkonen et al., 2012b).

2.2 Gamification and Exercise Motivation

Gamification refers to the use of game elements in non-game contexts (Deterding et al., 2011). The common purpose of gamification is to motivate users to behave in desired ways by making the user experience more playful and enjoyable (Deterding et al., 2013). Implementing gamification has become very popular in various different contexts (Hamari, Koivisto & Sarsa, 2014b). As the utilization of gamification has grown, it has become a subject of growing interest in academic research as well (cf., Hamari, Koivisto & Pakkanen, 2014a; Hamari et al., 2014b).

Kari et al. (2016b) proposed recently that a division should be made between the process of gamification and the experience of gamification. Kari et al. (2016b, p. 400) define the process of gamification as “using a set of activities with the aim to implement game elements to non-game context” and the experience of gamification as “a use experience in non-game context that the user perceives as gameful”. Commonly, the process of gamification aims to create an experience of gamification for the user. Yet, the experience of gamification can also arise from non-gamified features (Kari et al., 2016b). In this study, the focus regarding gamification is especially on the experience of gamification.

Gamification can be an efficient approach to influence user behaviour and use of an application (Law, Kasirun & Gan, 2011). It can also have a positive impact on motivation in general, but differences occur between different solutions, elements, and also between individuals (e.g. Fitz-Walter, Tjondronegoro & Wyeth, 2012; Gawley et al., 2016; Hamari et al., 2014b; Kari et al., 2016b). In the context of wellness technology, these individual differences can be traced to such personal characteristics as attitudes towards sports technology, exercise habits, and competitiveness. Different people also experience gamification in different ways (Kari et al., 2016b). Overall, the experience of gamification can influence a user’s exercise motivation positively (Kari et al., 2016b). A recent study shows that the relevance of gamification in wellness domain will continue increasing (Kari et al., 2016c)

3 Methodology

This study followed a qualitative approach. It can be defined as a diary study based on phenomenographic approach. Phenomenography is a research method originally developed by Ference Marton (1981) in Sweden. As the name suggests,

phenomenography is linked to phenomenological philosophy, in which the attention is directed to the world as humans experience it. Hence, the research object here is the human experience on the use of wellness technology in everyday life. Phenomenography is especially popular research method in educational sciences, but lately it has been adapted to information systems (IS) research as well (see e.g. Kaapu & Tiainen 2012). Phenomenography was well suited to the research setting, since phenomenography brings out the essential in users' view and can reveal the variation in it.

Phenomenographic studies are usually based on textual data, e.g. transcribed interviews, essays, or diaries. In the research setting of this study, user diaries were selected as data collection methods. Diary study was selected as the method because its ability to provide more authentic information on human-technology relationships and technology use in situ (e.g. experiences and feelings), as the so-called presentation effects (i.e., participants may act differently due to the presence of a researcher) are diminished (Carter & Mankoff, 2005).

The voluntary participants for this study were recruited from a list of participants from an earlier study. They had expressed to be available to participate in research related to sports and wellness technology. The goal was to get 15 to 20 participants for the study. To recruit the participants, during late 2015, invitation e-mail to participate in the study was sent out to 50 potential participants, out of which 35 replied. Out of those 35 who replied, 22 signed up for the study. No restrictions were placed regarding the participants (e.g. their demographics, physical activity level, wellness technology usage, gamification activities), as the goal was to reach varying kinds of participants. However, all the participants were from Finland. The participants were asked to keep a diary of their wellness related technology usage and perceptions for six weeks. They were also asked to provide basic demographic information on a separate sheet. All the participants received an information letter, in which the central terms – wellness technology and gamification – were explained. The participants were also given instructions regarding keeping the diary. They were especially asked to focus on three different aspects in their diaries and write down opinions, thoughts, feelings, experiences, and perceived effects regarding: 1) Wellness technologies and their use, 2) wellness technology and gamification (e.g. using wellness technologies with gamified features, gamifying different health behaviours, experience of gamification), and 3) perceptions on other people's views on one's own wellness technology use and gamification. They could choose how to keep the diary themselves. All the participants wrote it electronically.

The participants were not given any strict time limits regarding when the six-week period should take place. The return dates of the diaries ranged from December 2015 to February 2016. After the six-week period, the diaries were returned electronically to one of the authors. Out of the 22 participants, four dropped out during the study. As a result, diaries were received from 18 participants. This can be considered to be an adequate amount for this qualitative study.

To analyse the data, thematic analysis was used. This analysis method is often used especially when researching matters of common everyday life, since it provides practical answers to the research problems (Eskola & Suoranta, 2014). It is also the most widely used analysis method of qualitative research (Guest, MacQueen & Namey, 2012) and enables organizing and describing the data with rich detail (Braun & Clarke, 2006). The actual data analysis was guided by Braun and Clarke (2006). Following their suggestion, the guidelines were adjusted to fit the research subject and the data. Thematic analysis was used to identify, analyse, and report patterns within the collected data. The analysis started with familiarizing oneself with the data and marking all the interesting features of it. The data was then divided into three different themes for each individual. The themes were as follow: 1) wellness technology use and perceptions in everyday life, 2) wellness technology and the experience of gamification, and 3) perceptions on other people's views regarding one's own wellness technology usage and gamification. After this, all three themes were separately studied by examining all the participants' answers under that particular theme and searching for similarities and differences. These were then reviewed in relation to the data. The analysis also aimed at interpreting specific aspects and exceptions of the investigated matter. Finally, the report was produced. As Braun and Clarke (2006) propose, the analysis process was a recursive and non-linear, as it moved back and forth between the different phases of analysis.

4 Results

In total, the study had 18 participants. Four of the participants were male and 12 were female. The age of the participants ranged from 18 to 70 and the average age was 39.6 years. More detailed description of the sample can be found from the appendix.

4.1 Wellness Technology Use

The wellness technologies used by the participants varied from activity trackers and heart rate monitors to smart scales and step counters as well as different mobile applications related to wellness and physical activity. Few also reported the usage of exergames – digital games requiring aerobic physical effort from the player (Kari & Makkonen, 2014) – or other gamified applications. The most common reason for acquiring a device or an application was to get more accurate data on personal exercising or health; data that is not only based on own feelings. GPS features were also considered as important by many participants. Most participants liked how they were able to get varying and interesting data with the help of wellness technology. Many were using the technology to control their exertion level during physical activity either by checking that they were not training with too high intensity or that they were training with intensity high enough.

Wellness technologies were also considered to have motivational elements, since they provided a reliable tool for setting goals. Most of the participants reported that wellness technologies had positively affected their motivation by enabling them to see and compare their own exercise data. Seeing longer-term improvement regarding exercise

and health typically added their motivation. For some of the participants, using a wellness technology device in their training made them train harder or longer. For example, being able to follow data while exercising could increase motivation to do more through running longer, lifting more weights, or training with higher intensity. “In indoor cycling, I speed up if my heart rate is too low, and while running it is motivating to see how far I have gone”.

Some participants reported they were intrinsically motivated to exercise and for some of them using wellness technology did not bring any extra motivation. Some participants reported wellness technology being able to increase their motivation during their more active exercise periods. However, when they feel less physically active, using wellness technology and seeing your own data could actually decrease exercise motivation. Respectively, some reported that when things are going well, the information from the technology makes one happy, but when things are going badly, the information from the technology can be annoying.

For some participants, wellness technology also had some educational effects such as learning more about training intensity, calorie consumption, and heart rate levels, and being able to better compare objective data to subjective feelings. This kind of learning-effect could also lead to discontinuance in using the technology, as it was felt that the technology could not provide any new or interesting information.

Some participants raised the question about the reliability of wellness technology. They highlighted the fact that their devices sometimes do not work properly. Participants found this annoying since they would rather focus on their own performance during the exercise than thinking whether their device works at that moment. Some participants also emphasised that people should not always blindly trust the information received from wellness technology since the information is never completely individualised for them. Some participants were also reluctant to value wellness technology data and its accuracy over their own feelings. Some were commenting that “Why can exercise be considered hard only then if the result is proven by a sport watch?”.

The most common negative remark about wellness technology was related to technical problems that occur during exercise. For some, this might even bring the feeling that the exercise has gone to waste; “If the heart rate monitoring stops working during exercise, I want to throw the device into a rubbish bin”. Another case when technology might bring negative feelings is when people forget to take it along to their exercises or when some wellness application does not work on a specific device. Some participants considered sport watches to be so big in size that they did not want to use them during any other time than while exercising, which limited their usefulness in tracking other everyday wellness related activities such as sleep or general activity.

While some participants felt it was “easy” to wear wellness technology devices, others felt wearing them was uncomfortable and sometimes even pointless, for example, when

their training focus was on strength training instead of aerobic training. In other words, the willingness to use technology was also partly associated with the conducted activity or sport. Few participants reported that keeping a log of their own exercises was hard work with or without the help of wellness technology. Some also emphasised the fact that some wellness technology devices and applications are too difficult to use. For one participant, tracking exercises created too much stress about exercising and therefore woke the need to stop using all devices.

Several participants associated wellness or sports technology use with hard and intensive training with set goals. They did not consider themselves as athletes and therefore did not see why they would need to use or how they would benefit from using wellness technologies. Some of them were afraid that adding new technologies to their exercise routines would take some of the fun away by making it more goal oriented and strict, subsequently decreasing the intrinsic motivation to be physically active.

The study also included four participants from the “young elderly” age group, i.e., 60–75 years of age (Carlsson & Carlsson, 2016). Studying the young elderly age group is deemed important, as they are a growing and a very large group of individuals with a rising need for different digital wellness solutions (Carlsson & Carlsson, 2016). Bearing in mind that the study only had four participants from this category, the data supports this notion by Carlsson and Carlsson (2016), as all the young elderly participants were using some sort of technology to support personal wellness. However, among the young elderly, the polarisation was quite apparent. At its simplest, the technology used by two participants was restricted to just a blood pressure meter or an electronic scale, whereas the other two were using sports computers with their various features and electronic training diaries. Interestingly, only one saw age as any kind of limitation regarding the use of these technologies.

4.2 Wellness Technology and the Experience of Gamification

Almost all participants who were using wellness technology reported they were comparing (a form of gamification) their own previous health and exercise related results to their current ones to keep track of their development and fitness level. This data was often received from a sport or wellness technology device. Some participants reported they compared their old and new data also to see how their technique had developed. This kind of comparison also seemed to wake experience of gamification. However, when it comes to sharing data in social media or comparing own data with other people’s data, the situation was different. Most participants felt their exercise data is personal. Few participants compared any of their data with family members’ data or to other people's data that can be seen, for example, in some web service. Only those participants who did some level of competitive sports, more constantly compared their results or data with their training partners. Considering this, it seemed that the experience of gamification rather comes from comparing own data with own data than comparing own data with data from others. An exception to this seems to be different voluntary physical activity

challenges that people can participate. Comparing own activity level to that of others within these voluntary challenges was seen as gameful and motivating by those taking part.

When participants explicitly reported about the type of gamifying they do, they also most often referred to comparing their own results with their own exercise history and data with the help of some technology. Some participants set a goal to reach enough daily activity, to walk or run the same route with a faster pace than before, or to be able to maintain a lower heart rate than in previous runs. Strength training was also reported to be something where the gamified aim is to reach the “next level”. More competitive exercisers reported gamifying by comparing their own training and race results to previous ones or trying to improve their own scores in competitions or lap times during training. Some participants reported to challenge themselves by tracking their weight on a regular basis. One participant reported using a gamified application to drink enough water. Overall, different technologies were regularly mentioned to support these gamified activities. Considering the motivational effect, many participants reported that this kind of gamifying brought extra motivation. One participant described that the activity tracker reminds a Tamagotchi (a digital pet that was hugely popular in the 1990’s) with the need to “feed it and keep eye on it on a regular basis”.

Few participants were also using gamified applications or doing geocaching, which as an activity is all about integrating technology into exercise by adding extra gamified elements into regular hiking, walking, or running session. For these participants, having the gamification element made them venture further and visit different places. Exergaming was also mentioned as a one form of exercise.

Among the young elderly, the participants’ reports were similar. Most commonly, the experience of gamification came from comparing own current data with own previous data – often with the help of some technology. This was also considered motivating and an enjoyable means to support reaching personal goals. One also mentioned occasionally playing exergames.

It seemed that some people also engage in a sort of self-gamification, which can be defined as a desire-based action to gamify some recurring activities or bodily functions. Pursuing the experience of gamification by self-gamification could begin as non-technical, but later on, some technology was implemented to support the gamifying.

4.3 Perceptions on Other People’s Views of Wellness Technology Use

Most of the participants neither shared their wellness related data with other people nor felt the need to tell anybody that they were tracking their wellness. Some felt exercising was their own personal thing and no one else’s business, and some were reluctant to show their results to anybody because they felt other people exercise more and have better results. Some believed that no one would be interested in whether or not they track their wellness or exercise, because it is considered so normal these days. Some had the

perception that many others usually view tracking as too difficult or time consuming and therefore not worth doing. Some reported that other people had asked them about their use of the device they were wearing.

Some participants were even a little bit ashamed of their exercising and results. One participant was worried to be seen as too old-fashioned if anybody knew about the habit of doing exercise with an exercise video. Another participant reported to be sure other people would consider geocaching to be a too childish hobby. Some applications also seem to have a negative image, and people were not eager to admit they were using such application. One such example was a calorie-tracking application, which was associated as a tool for overweight people.

One participant felt embarrassed to wear a sport watch due to feeling concerned to be seen as an athlete by others, even though being just a regular exerciser; “In badminton it can be embarrassing to wear a sport watch since my opponent is better than I am. It makes me feel I take this too seriously. I try to start my watch in a way that is as unnoticeable as possible”.

The perceptions were similar among the young elderly. If anything, they seemed to feel even more strongly about not wanting to share their own personal data with other people. They also believed that their friends would not be interested in their own data. Respectively, they reported to be very uninterested in the data of their friends.

Even though there were more negative perceptions regarding other people’s views on personal wellness technology use, a few participants reported they felt proud and got extra motivation when other people saw them doing something different and positive such as running or using a wellness technology.

5 Conclusion

The purpose of this study was to deepen the understanding of how people use and perceive wellness technologies in their everyday lives. The focus was also on related gamification and perceptions regarding other people’s views. A qualitative diary study based on phenomenographic approach was conducted. The study included diaries from 18 participants who kept diaries for six weeks regarding their wellness technology usage and related issues.

The most common reason for acquiring a wellness technology was to get more accurate and objective data. Motivational effect was also an important factor behind acquiring one. Based on the data, it seems that the use of wellness technologies can positively influence wellness motivation. For some, a mere buying of a device brings additional motivation, but for the majority, being able to follow personal progress by receiving objective data and that way comparing own results to previous results is the key motivational factor. This implies that it would be worthy for the designers and the parties aiming to increase

people's wellness to provide technologies with features that enable following one's own progress in desired areas of wellness.

In general, wellness technologies can help people to learn more about the level of physical activity and training effects. Regarding the finding that a learning-effect could lead to discontinuance in using the technology, it demonstrates that even if the user would stop using the technology, it does not necessarily mean that the technology or its use would have been a failure, but instead a success in a way of being able to teach the user the things he or she wanted to know. This was an interesting new finding and something to consider, for example, when investigating the retention or use continuance with these technologies and also IS in general.

The biggest concerns the users seem to have are related to the situations where the device stops working during an exercise or for some reason does not record the entire exercise session properly. For some, this may even be a reason to stop exercising. Therefore, to achieve longer-term motivation, for some people it would be better to use devices and applications they are already familiar with. Both users and those promoting wellness should acknowledge this. Another concern was related to wearing a wellness device, such as a sport watch. Whereas some described wearing one to be perfectly "easy" and normal, some reported not feeling comfortable wearing one outside exercising or sometimes not even when exercising. This obviously limits their usefulness in tracking other daily wellness related activities. Thus, these devices should be designed as ubiquitous and as easy-to-wear as possible, also acknowledging the look of the device and the different user groups.

Regarding gamification, the most common type of gamifying seems to be comparing personal results or data with previous personal data – usually with the help of some technology. This kind of comparison also seemed to wake experience of gamification, which, in turn, was reported to influence motivation positively. It also seems that some people engage in self-gamification, which we define as a desire-based action to gamify some recurring activities or bodily functions. Interestingly, pursuing the experience of gamification by self-gamification can begin as non-technical, but later on, be supported by the use of some technologies. In general, including a gamification element to wellness related activities seems to bring extra challenge, motivation, or even make the activity as more enjoyable. Thus, people struggling with their wellness motivation could try self-gamification or some gamified technological wellness solutions. The designers should undertake the process of gamification, for example, implement their devices and application with gamified features. The societal parties working with wellness promotion might be able to increase the effectiveness of their interventions with gamification.

With the exception of more competitive individuals, most participants did not feel the need to share their training data with other people since the information was generally considered personal. Some were also concerned how other people view their wellness technology use. This implies that the marketers of these solutions could benefit from

making it seem that the use of these devices is common and socially acceptable among their target audiences.

Regarding the young elderly, experiences of gamification were similar with people of other ages. Compared to others, they felt more strongly about the personality of their own data and felt it to be uninteresting to others. Regarding the usage in general, there seemed to exist polarisation among the participants. These findings support the call made by Carlsson and Carlsson (2016) about the need and importance of studying the habits and experiences that the young elderly have with digital wellness solutions.

This study provides interesting insights into people's everyday use of wellness technologies. The results assist the scholars and wellness technology providers in deepening their understanding on wellness technology usage. The developers can utilize the findings in providing and marketing solutions that are better welcomed by their target audiences. The findings may also assist people working in the healthcare sector in implementing different wellness technologies for health and wellness related purposes.

6 Limitations and Future Research

There are few limitations to the study that should be noted. First, studies concerning wellness and exercise behaviour at some level have been known to include the challenge that research subjects may intentionally report their behaviours as more positively than in reality, thus biasing the responses. However, the participants of this study were emphasized that the wellness and exercise behaviour itself are not relevant regarding the study but rather the experiences and perceptions regarding wellness technologies and their use. The intention of this was to minimize the possibility that participating in the study would lead the participants to intentionally change their behaviour. Second, the study was based on the diaries from 18 participants. Although providing a great amount of information, the amount of data should be considered when assessing the results of the study. Especially so in regards with the young elderly, as there were only four of them. One should also consider the female-dominance in the sample. Third, the level of detail in reporting in the diaries varied between the participants. Despite these limitations, this study provides some highly valuable new insights into the subject.

Future research could collect diary data from a longer time period and focus on possible behaviour changes regarding wellness behaviour and the usage of wellness technologies. Future research could also repeat similar research with particular focus on some specific user group, for example, the young elderly or athletes. Overall, the whole area of wellness technology usage continues to be an important topic of research.

Appendix A. Description of the Sample

Participant	Gender	Age	Employment status	Household type
1	Female	28	Employee	One family without kids
2	Female	31	Employee	One family without kids
3	Female	22	Student	One family without kids
4	Female	25	Student	One family without kids
5	Female	31	N/A	One family with kids
6	Female	33	Employee	One person
7	Female	57	Employee	One family without kids
8	Female	28	Unemployed	One family with kids
9	Female	55	Employee	Single parent
10	Female	63	Unemployed	One person
11	Female	66	Pensioner	One person
12	Female	30	Home parent	One family with kids
13	Male	18	Student	N/A
14	Male	33	Employee	One family without kids
15	Male	34	Employee	One family without kids
16	Male	66	Pensioner	One family without kids
17	Female	70	Pensioner	One family without kids
18	Female	22	Student	Single person

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Activity Trackers Influencing Motivation and Awareness: Study Among Fitness Centre Members

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Abstract Consumer fitness technology products are becoming increasingly popular. This leads to interesting questions about the influence of activity trackers on a person's motivation to exercise. This study explored the role of activity trackers in motivating fitness centre members towards exercising and in increasing their awareness regarding their own health and physical activity. The study included 100 fitness centre members divided into a test group and a control group and three sub-groups: OLD, NEW, and personal trainer (PT) members. The focus was on gym visit frequency during a 10-week test period and on tracking the consistency of activity levels. Participants also completed a pre and post study questionnaire assessing changes in their health and physical activity awareness. The results suggest that an activity tracker does not significantly influence fitness centre members' gym attendance or overall physical activity levels. Group comparisons reveal no statistically significant differences between groups, but observations of the descriptive statistics indicated that an activity tracker can bring some inspiration and other benefits, especially for PT clients and people who are just starting their new more physically active lifestyle. Using an activity tracker increased participants' perceived awareness of their own wellbeing, daily sitting time, and amount of sleep.

Keywords: • Activity Tracker • Motivation • Goal Setting • Fitness Centre
• Health Awareness • Physical Activity •

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1 Introduction

The health benefits of physical activity are widely known, yet still the participation rates in regular physical activity are below recommendations (Middelweerd et al., 2014). Commercially available physical activity monitors are becoming increasingly popular for personal use and the entire field of wellness technologies is expected to grow significantly (Grand View Research, 2016). There has also been a substantial interest in scientific research to objectively study individual and group level physical activity and in the role of wellness technology to increase adherence to physical activity guidelines or to be physically more active (see e.g. Marcus, Ciccolo & Sciamanna, 2008). Wearable activity monitors have the potential to help people reach their fitness and health goals by constantly monitoring and giving feedback on activities and bodily responses. Wearable devices may have various applications in other areas, such as in medical safety settings, or leisure and entertainment.

Activity trackers and other wearable devices have been found to bring a variety of benefits for their users. For example, Hagströmer, Oja and Sjöström (2007) found that objectively obtained estimates of physical activity yielded different activity patterns and lower values compared to those that were obtained by self-reports. This shows that wearable devices often provide more accurate data compared to self-perception and, therefore, serve as more reliable information source when planning and executing health behaviour change programs. Kari et al. (2016a) found that using a mobile exercise application can enhance the awareness of personal physical activity and motivate towards being more physically active. Moreover, activity trackers could have even more potential in increasing the amount of physical activity, as suggested by Kari et al. (2016b). Yet, it seems that the perceived increase in wellbeing would require a long enough use period for the user to notably perceive any changes (Kari et al., 2016b). A mere tracking of wellness related data may result in increased awareness of daily activity, but may not be sufficient to maintain the use of wellness technologies (Miyamoto et al., 2016). The use of wellness related technology is also more effective the more frequently it is used (Wang et al., 2016). The intention to use such devices is mostly based on utilitarian reasons but also hedonic perceptions play a role (Makkonen et al., 2012a; Makkonen et al., 2012b). O'Brien et al. (2015) evaluated the utility and feasibility of activity trackers among older adults, and found that most users experienced positive outcomes. They also suggested that activity trackers could be useful in improving older adults' health by monitoring and promoting physical activity (O'Brien et al., 2015).

As the popularity of activity trackers is growing tremendously, there is an increasing need to conduct more research on their use. These kinds of investigations enable a deeper understanding of the influences activity trackers have on people's behaviour. Much of the prior research has concentrated on the feasibility of individual solutions rather than the human aspects, such as psychological and social variables. For companies producing wearable devices or using the devices with their clients, sustained consumer engagement has been named as one of the key challenges. To achieve sustained consumer

engagement, the companies must understand behavioural science and study motivation, habit formation, and progress toward goals (Endeavour Partners, 2014).

The aim of the study was to investigate how using an activity tracker can influence participants' physical activity behaviour and motivation. It was not the aim of the study to encourage participants to increase or change their exercise behaviour in some way, rather, it was to investigate how the activity tracker influences their exercise behaviour. The main research questions of the study are:

1. Do activity trackers influence fitness centre members' gym attendance and overall physical activity level?
2. Do activity trackers influence the fitness centre members' awareness of their physical activity and health related issues?
3. Do activity trackers have a different influence on members with different lengths of membership history or personal trainer members?

The activity tracker used in this study was the Polar Loop by Polar Electro Finland (see Polar, 2016). The group using an activity tracker is referred to as the Loop group. The study includes 100 fitness centre members divided into a test group (Loop group) and a control group. Both groups were also divided into three sub-groups: OLD, NEW, and personal trainer (PT) members.

Considering the claimed benefits and the rising popularity of wearable activity trackers, the results of this study can benefit several stakeholders. The new knowledge it provides can have theoretical implications for scholars as it increases our understanding on the usage of these devices. The study can also provide practical implications for exercisers, manufacturers, fitness centres, and those working with physical activity promotion.

2 Theoretical Framework

2.1 Motivation and Physical Activity

Motivation can be divided into intrinsic and extrinsic motivation (Ryan & Deci, 2000). Self-determination theory is a major component in the discussion of intrinsic and extrinsic motivation and physical activity. Self-determination consists of three psychological needs: autonomy, competence and relatedness. Autonomy refers to the need to be self-initiating in the regulation of personal behaviour, competence represents a person's need to interact effectively within their environment, and relatedness reflects the person's need to feel connected to other people. The feeling of these needs can separate or together facilitate intrinsic motivation (Carron, Hausenblas, & Estabrooks, 2003).

The most common motives for getting involved with physical activity and exercise are extrinsic factors, such as improved health, improved fitness, or weight loss. However,

although extrinsic motives act as catalysts, the focus can often change between initial adaptation and subsequent adherence. This change also applies to the change in the level of self-determination: from non-self-determination to limited, to moderate and finally to full self-determination (Carron, Hausenblas, & Estabrooks, 2003).

This study included participants who had different membership periods. “OLD” members were defined of having been going to the gym for more than 9 months, and “NEW” members had been going to the gym for less than 2 weeks. Therefore, it can be assumed that OLD and NEW participant groups might have different levels of self-determination and differences in their types of motivation.

Goal setting techniques have been used extensively to enhance motivation and adherence and to improve performance. Studies conducted in exercise settings showed that 99% of participants set multiple personally motivating goals for their exercise participation. These goals were perceived as influencing actual exercise behaviour and helped people acknowledge what exercise behaviour is needed in order to meet their goals. Goal setting also helps people maintain their exercise program and keep up motivation to maintain their level of activity. Goal setting can therefore be seen as a way to maximize effectiveness in reaching exercise and physical activity objectives. The most effective goals in exercise settings tend to be flexible goals that people have set for themselves. (Berger, Pargman, & Weinberg, 2007).

According to Abraham and Michie (2008) there are various behaviour change techniques, all of which have different positive aspects. The key is to find the right technique to apply in the correct setting and with the target group. Techniques promoting specific goal setting, self-monitoring of behaviour, review of goals, and performance feedback are considered to be effective (Abraham & Michie, 2008). Health behaviour change interventions tend to be more effective if they are firmly connected with a health behaviour change theory (Middelweerd et al., 2014).

Participants were not asked to set any specific goals for themselves. However, Polar Loop users were asked to set their activity tracker to a setting (activity level on 1–3 scale) that best fit their everyday life. This affected the daily activity goal provided by the tracker. Even though Loop group members were not asked to try to meet the daily activity goals, the activity tracker can still be seen as a goal setter by giving people a target for how physically active they should be according to their set activity level.

2.2 Transtheoretical Model of Health Behaviour Change

Most health related behaviour change programs have concentrated on negative behaviours, such as alcohol consumption, smoking, or obesity, rather than focusing on increasing positive behaviour such as physical activity and exercise. It is extremely hard to change long-term habits. Behaviour change is a process that occurs over a long time period. The transtheoretical model divides this process into different stages that occur in

a cyclic model. The stages are precontemplation, contemplation, preparation, action, and maintenance. (Prochaska & Velicer, 1997).

The transtheoretical model has been applied to many health behaviour programs (Spencer et al., 2006). In this study, the transtheoretical model was used as a theoretical background for designing the questionnaire. Participants self-evaluated their current stage in becoming more physically active before and after the 10-week test period. However, it is important to remember that 10-weeks is a short time to make any real changes between the stages and therefore the results concerning behavioural change should be interpreted with caution.

According to Bandura's (1997) social cognitive theory there are different reasons why people might need outside help (proxy agent) in order to better reach their set goal. Firstly, people might have lost their means to reach their desired outcome. Secondly, they might think that a third person is more capable of facilitating the achievement toward the desired outcome. Finally, people may want to give control over to somebody else because they want to shift the responsibility of the direct control (Bandura, 1997). In an exercise and physical activity setting the use of proxy agent, often a personal trainer, helps a person to manage environment and task demands as well as gives extra help in regulating and controlling exercise behaviour, developing new skills and helping in lifestyle management (Beauchamp & Eys, 2007). Having a proxy agent also provides a person social support which increases positive outcomes. This can lead to greater likelihood of experiencing full involvement, focus, and enjoyment (Jowett & Lavallee, 2007).

3 Methodology

3.1 Study Design and Data Collection

The study follows a quantitative experimental design. The study was carried out among members of a fitness centre located in Finland. The study consisted of two main groups: the test group (Loop group) and the control group. The Loop group members were given Polar Loop activity trackers and H7 heart rate sensors in the beginning of the test period, whereas the control group did not receive these devices. After the study, the Loop group got to keep their devices, and the control group were also given Loops as a reward for participating. The two main groups were further divided into three sub-groups: OLD members (members for at least 9 months), NEW members (members for under 2 weeks) and personal trainer (PT) members (having at least six PT sessions during the study). Participants were recruited via the fitness centre's e-mail newsletter. All club members were allowed to apply for the study and the first 100 suitable candidates were selected and randomly split into the Loop Group or control group. Both groups had the same number of male and female participants. From the 50 participants in the Loop group, 25 were OLD, 13 were NEW, and 12 were PT. Table 1 shows the number of participants in each group.

Table 1: Description of the participants

Group	Sub-group	N	Female	Male	Average age
Loop	OLD	25	14	11	42.52
	PT	12	10	2	41.67
	NEW	13	8	5	33.08
	Loop total	50	32	18	38.09
Control	OLD	25	14	11	38.04
	PT	12	10	2	40.42
	NEW	13	8	5	28.54
	Control total	50	32	18	36.32
Total		100	64	36	37.91

The Loop group was asked to create a Polar Flow account, which made the training observable for research purposes. Data was also collected from the fitness centre's visitor database, which recorded all the fitness centre visits participants did during the 10-week test period. In addition, a questionnaire concerning the members' perceptions regarding their own health and fitness and the possible changes the 10-week test period had on them was collected from the participants before and after the test period. The questions were identical both times. The questionnaire included questions regarding current physical activity, sleeping time, daily sitting time, and awareness regarding their own overall wellbeing. The participants could also give feedback regarding their experiences during the study period after the study ended. In the results section, the experiences concerning Loop are reported. The full questionnaire is available from the authors by request.

In total, three different data sets were used: 1) One obtained from Polar Flow service, which showed weekly activity goals based on the activity level set on the device, and how well these goals were achieved. 2) One obtained from the fitness centre's visitor database, which was used to compare the Loop group and the control group as well as their sub-groups to see whether there were differences in physical activity measured by gym visits. 3) One obtained by the pre- and post-study questionnaires, which was used to investigate the changes in the perceptions of the participants.

3.2 Data Analysis

The quantitative data from Polar Flow and the visitor database was analysed with IBM SPSS Statistics 21. The data from the questionnaires was transformed into numeric data and also entered to SPSS for further analysis. Means, age range and frequencies were computed in order to obtain the basic information of the test group. This was followed by

the test of normality, which was done by using the Kolmogorov-Smirnov test for the main groups and Shapiro-Wilk test for different sized sub-groups.

Next, the analyses concentrated on the first measurement, which related to gym visit activity. An independent sample T-test was done in order to test differences between the Loop group and control group. Here, the independent variable was the group and the dependant variable was the number of average weekly fitness centre visits within the 10-week period. The same test was also done to compare the sub-groups between the Loop and control group. When testing differences within the Loop group or control group the test method was oneway ANOVA. The same method, oneway ANOVA, was also used in measurements concentrated on Loop group weekly activity percentages and their development. Here the independent variable was the sub-group and the dependent variable was the weekly average activity percentage within the 10-week test period. The last phase of the SPSS analyses was done by using repeated measures MANOVA to test for differences before and after the 10-week period among groups.

4 Results

The tests of normality were conducted to investigate normality for the main variables; average gym visits and average activity percentages (only Loop group). The normality tests were done after dividing the data into different sub-groups. Results for the Kolmogorov-Smirnov test for normality indicated that average gym visits were normally distributed within OLD sub-group ($D = .110, p = .185$). Due to the smaller sample sizes (< 50) for other sub-groups, the results from the Shapiro-Wilk test were more appropriate. These tests indicated normal distribution in all sub-groups.

4.1 Gym Visits and Activity Percentages

Regarding the amount of gym visits, T-test was done in order to investigate differences between the Loop group and control group. No statistically significant difference was found, but it can be seen (Table 2) that the average visit amount for the 10-week test period was higher with the Loop group (16.5) compared to the control group (14.8).

Table 2: Gym visits – group comparison

Group	N	Gym visits Mean	Std. Deviation	Std. Error Mean
Loop	50	16.5	11.7	1.7
Control	50	14.8	10.2	1.4

A similar comparison was made between Loop group sub-groups and control group sub-groups. No statistically significant differences were found. OLD members in the control group had a higher average compared to the OLD in the Loop group. With the PT and

NEW members' gym visits, it was the opposite. Within both PT and NEW, the Loop group average gym visits were higher than in the control group (see Table 3).

Table 3: Gym visits – sub-group comparison

Sub-group OLD	N	Gym Visits Mean	Std. Deviation	Std. Error Mean
Loop	25	13.7	9.8	2.0
Control	25	14.2	11.3	2.3
Sub-group PT	N	Mean	Std. Deviation	Std. Error Mean
Loop	12	21.8	14.5	4.2
Control	12	17.4	9.2	2.7
Sub-group NEW	N	Mean	Std. Deviation	Std. Error Mean
Loop	13	17.1	11.5	3.2
Control	13	13.9	9.2	2.5

Figure 1 shows the development of the average gym visits compared by sub-groups. All groups experienced a slight decrease in weekly gym visits.

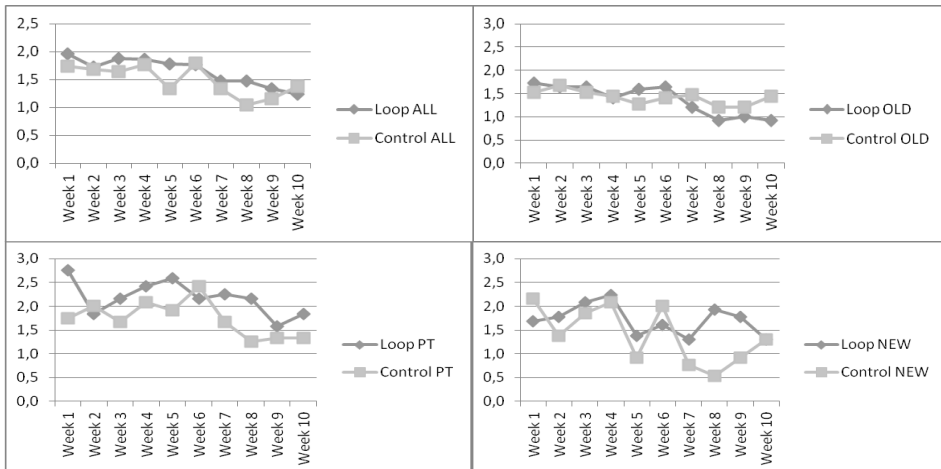


Figure 1: Loop group and control group gym visit development comparison

Regarding how well the Loop sub-groups achieved the weekly activity goals provided by the tracker, the Loop's weekly activity percentage measurements were used. The Loop activity tracker measures the accumulated activity as a percentage of the weekly goal. A

100% measurement means a user has achieved that goal. It is also possible to exceed the weekly goal and have a measurement higher than 100%. No statistically significant differences were found between Loop sub-groups in weekly activity percentages. Similar to gym visits, all Loop groups experienced a slight decrease in weekly activity percentages during the test period. However, the decrease was larger with gym visits (see Figure 2). When comparing different Loop sub-groups, the decrease in activity percentages was strongest within OLD, whereas within PT and NEW groups, the decrease was almost non-existent.

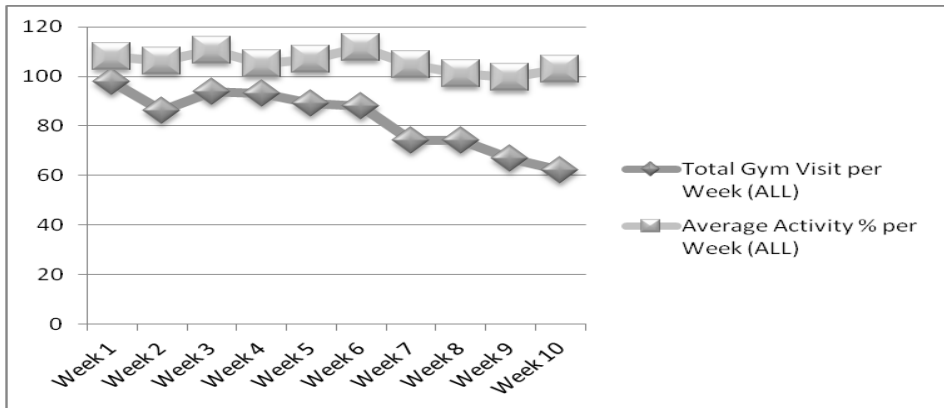


Figure 2: Loop group activity percentage and gym visit trends

Pearson correlation test revealed that gym visits and activity percentages were positively correlated (see Table 4).

Table 4: Correlation between gym visits and weekly activity percentages

		Weekly gym visits	Weekly activity %
Gym visits week	Pearson Correlation	1	.524
	Sig. (2-tailed)		.000
	N	50	50
Average weekly activity	Pearson Correlation	.524	1
	Sig. (2-tailed)	.000	
	N	50	50

4.2 Questionnaire Results

All participants received a questionnaire at the beginning and end of the test period. The questionnaire included seven different health, exercise, and gym satisfaction related

questions that participants answered based on their own subjective feelings. There were no statistically significant differences in the results of the questionnaires, but some trends were seen.

Participants were asked how active they perceived being before and after the 10-week test period. The overall trend was that participants felt they were more physically active after the test period. The only sub-group that perceived a decrease was the Loop group OLD (see Figure 3).

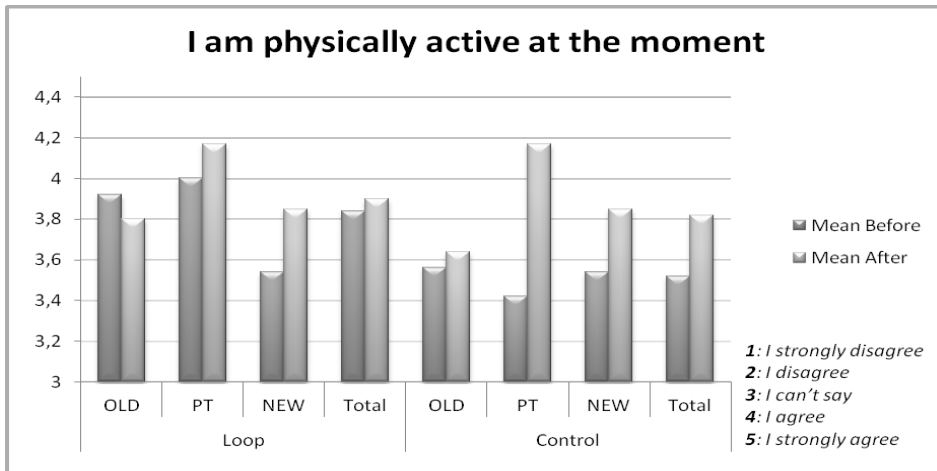


Figure 3: Perceived current physical activity level

After subjectively estimating their own physical activity level, the participants rated their own satisfaction related to their activity level. Satisfaction levels of all groups increased after the test period, with the exception of the Loop OLD group, which experienced a decrease in their level of satisfaction (see Figure 4).

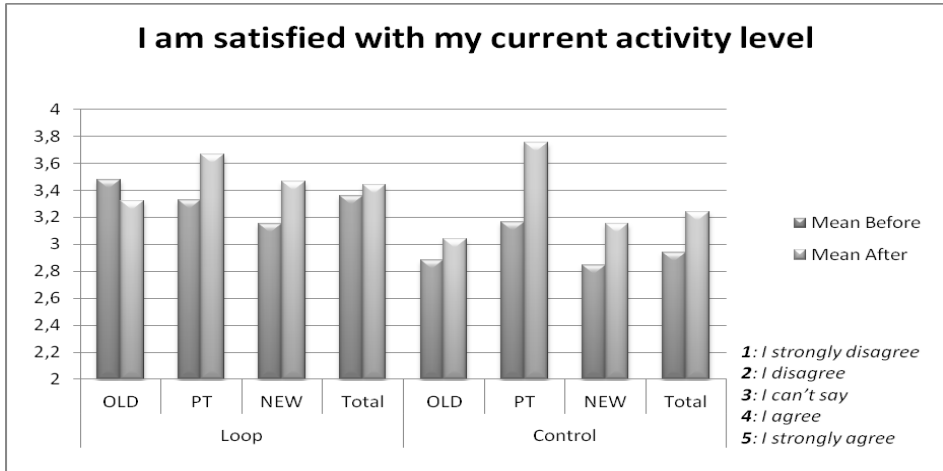


Figure 4: Physical activity level satisfaction

One question measured how satisfied the participants were with their sleeping time and whether they thought it was sufficient. Results showed that all Loop group sub-groups experienced an increase. The result was opposite in the control group. This indicates that Loop usage increased the Loop group participants' awareness of their own sleeping, and perhaps also persuaded them to sleep more (see Figure 5).

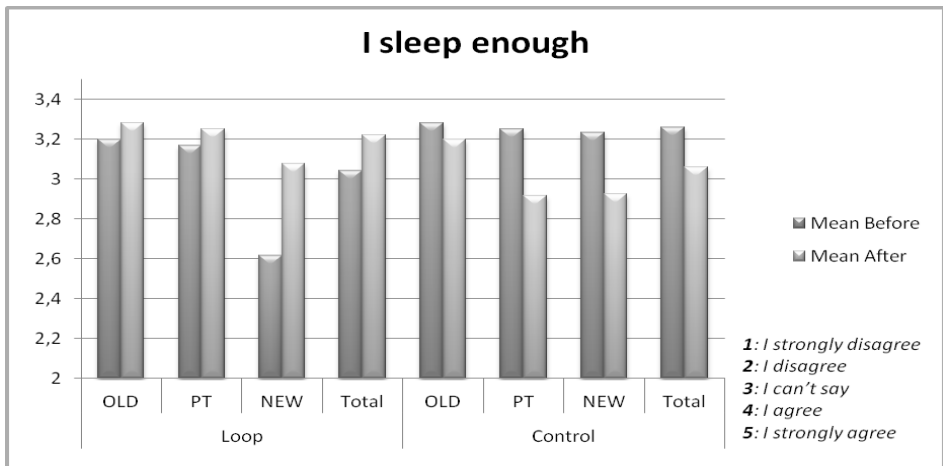


Figure 5: Perceived sleep amount

One question concerned the daily sitting time and whether participants thought they sit too much during the day. The Loop group experienced small increases in all sub-groups except the NEW group. In the control group participants were more certain after the test period that they do not sit too much during the day (see Figure 6).

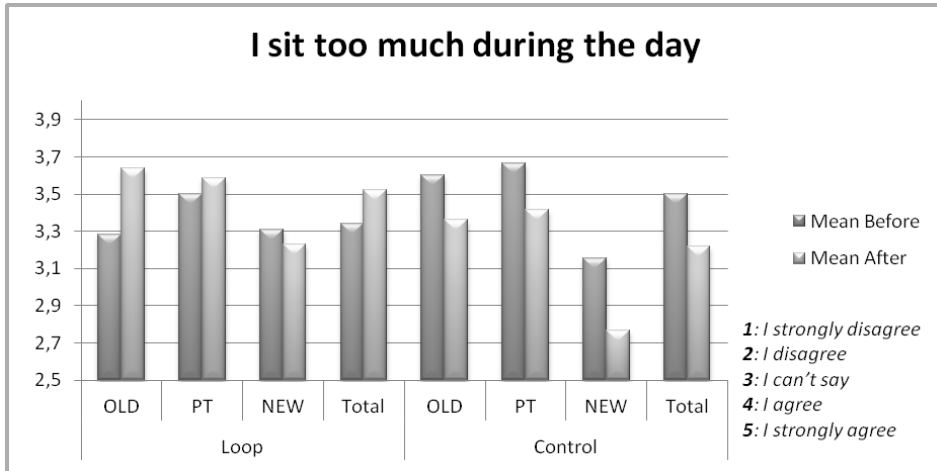


Figure 6: Perceived daily sitting time

One of the questions concerned participant's awareness of own state of wellbeing. The results show Loop group participants had an increase in their perceived awareness during the test period. The results of the control group show a small decrease in their perceived awareness (see Figure 7).

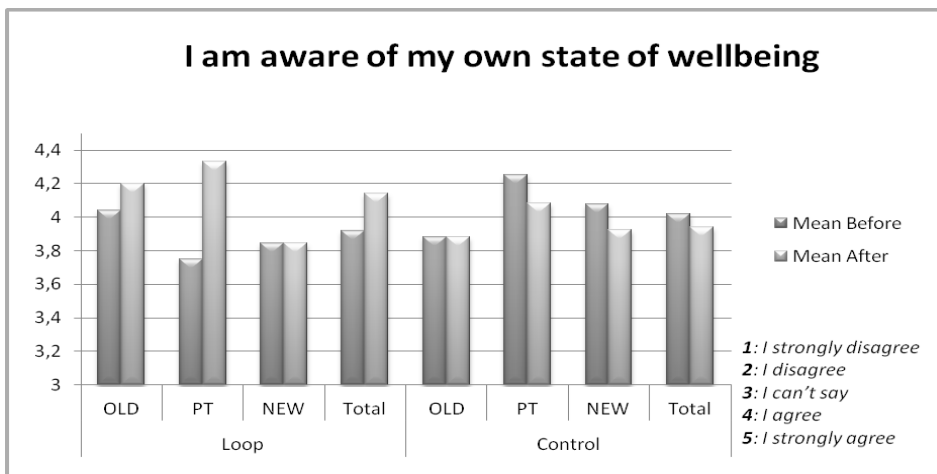


Figure 7: Perceived awareness of personal wellbeing

One question was based on the transtheoretical model measuring the participants' progress toward a more physically active lifestyle during the test period. The Loop group experienced a small positive increase, and after the test period they perceived to have a more physically active lifestyle than before (see Figure 8). The results were the same with the control group OLD sub-group, but otherwise the control group experienced a

marginal decrease. The biggest difference between matching sub-groups of Loop and control was in the NEW sub-group. The Loop NEW group perceived a greater increase than control NEW group, which suggests that the Loop can be a useful tool to encourage a more physically active lifestyle for those (new members), who perhaps are more novice with physical activity in general. It should be noted that ten weeks is a relatively short time period to make significant changes or even take a step between levels, so these findings should be considered with caution.

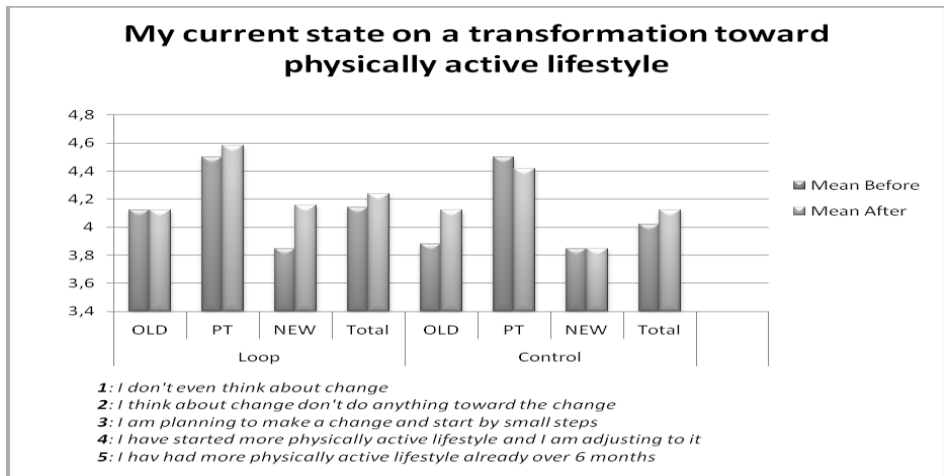


Figure 8: Perceived state of transformation

4.3 Feedback

Most of the feedback related to the Polar Loop was that participants had learned more about their own wellbeing no matter what their initial starting point was. Some participants mentioned that Loop had changed their awareness and perceptions of their sleeping time, sitting time, and overall physical activity. Some critical comments were related to Polar Loop functions and how the activity tracker was not suitable with the participants own existing devices. A few comments were also related to the pressure that the Loop and goal setting had created; whereas some people felt it was positive and motivating, others first experienced it negatively but eventually learned to cope with it. Only one participant quit using Loop in the beginning of the test period because they felt too much pressure to reach the set goal every day.

5 Conclusion

The purpose of this research was to study the role of an activity tracker (Polar Loop) in influencing fitness centre members' motivation and awareness regarding their own health and physical activity. The study followed a quantitative experimental design and included 100 fitness centre members divided into test and control groups.

Although the investigation revealed no statistically significant differences between different groups, some interesting findings can be reported. On average, participants with a Polar Loop visited the gym more often than those without, though the difference was not statistically significant. There was a small decrease in gym visits and activity trends during the 10-week test period in both main groups and in all sub groups. Thus, it can be assumed that an activity tracker alone might not be enough to sustain motivation to visit the gym or to be physically active, but can bring some benefits. Regarding the transformation towards a more physically active lifestyle the difference between Loop and control groups was not statistically significant. On a sub group level, the differences were also not statistically significant, but the results suggest that for new fitness centre members, an activity tracker could provide some tools for achieving intrinsic motivation, which is important when trying to maintain a more physically active lifestyle in the long-term. The results also suggest that there might be a reciprocal benefit where a personal trainer can use the extra information provided by the device to plan the training, while the user can utilize the personal trainer's knowledge to better understand the data. Overall, it can be concluded that an activity tracker may not significantly influence fitness centre members' gym attendance and overall physical activity levels but might make them more aware of their health and physical activity which is needed in building long lasting motivation.

Considering the high number of fitness centre members who volunteered for the study, it is probable that the Polar Loop worked as an extrinsic source of motivation. Previous studies have shown that exercise applications may increase exercise level and health outcomes leading to increased level of self-efficacy (Litman et al., 2015). Based on some of the participants' feedback, it was appreciated that Polar Loop offered a tool for personalized goal setting and also provided the participants with personalized information. Providing personalized feedback and increasing awareness about health related issues, the activity tracker may have increased the participants' level of perceived competence, which is one element in enhancing intrinsic motivation. Thus, in order to help turn the motivation more intrinsic, an activity tracker should provide personalized information and offer a tool for personalized goal setting.

Regarding the awareness of personal health and physical activity, on average, both main groups claimed to be more physically active at the end of the study period. This subjective feeling does not match the fitness centre data, which showed that participants in all groups went to the gym less often in the latter part of the study period. Loop group members also seemed to be less active at the end of 10-week period based on the Loop activity percentages. The satisfaction towards one's own physical activity level followed the development of perceived activity level. These findings support the ones by Adams et. al. (2005), that there can be some biases in self-reports of physical activity.

The finding that the Loop group were more concerned about their daily sitting time at the end of the test period, suggests that the information the Loop provided made them more aware and more concerned about their daily sitting time. Thus, activity trackers could be

used to educate users about their sitting or other inactivity habits. The results also suggest that an activity tracker might increase a person's perceived awareness of their own state of wellbeing. Whereas the Loop group perceived an increase in their awareness, the control group perceived a decrease. A similar result was found regarding the perceived sleep amount, as the Loop group reported being more satisfied with their amount of sleep, while the control group reported a decrease in satisfaction. Overall, it can be concluded that there are several influences an activity tracker has on one's awareness of personal physical activity and wellness related behaviour. However, given the contradiction between perceived and measured physical activity levels, the influence can be both positive and negative.

Electronic monitoring of daily physical activity can offer tremendous opportunities for people to independently improve their health and wellbeing. However, it is important for the stakeholders working in related fields to acknowledge that the key is not to just implement a device but to find out how the electronic devices are able to deliver useful information that is also motivating and easy to understand for diverse populations.

6 Limitations and Future Research

This study has some limitations. The first limitation concerns the sample size, which could have been higher. Even though the sample size is large enough for conducting the statistical analyses and can present the situation among the members of the particular fitness centre, it somewhat limits the generalizability to activity tracker users in general. The second limitation concerns the length of the study. A 10-week period is not necessarily long enough to facilitate changes in awareness or gym visit habits. Particularly, as according to the transtheoretical model of change, it might take several months to generate changes in habit formation.

One potentially interesting avenue of future research would be to do a similar study with a larger number of participants, which would provide better statistical representation of the target population. This study could also be done by having a longer study period which would give more reliable results and allow to the transtheoretical model assessment tools to track changes. A follow up questionnaire and measurements could also be done in order to see how the training motivation has developed after end of the study period. Similar study could also be conducted in different fitness centres. Future studies could also include gamification as a motivation driver as well, and examine it more deeply, as it seems that its relevance in this domain will continue increasing (Kari et al., 2016c).

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CustomerSourcing: Intrinsic Motivators

FRED KITCHENS & CAMERON CRANE

Abstract Crowdsourcing is a well-developed concept, which has become very prevalent with the growth and development of the Internet; Web 2.0 in particular. CustomerSourcing is a sub-category of Crowdsourcing which has developed a following in recent years. This article explains the development and conceptual underpinnings of CustomerSourcing; followed by the introduction of a 16-point framework for identifying specific intrinsic motivators. The motivation framework is applied to the major categories of Crowdsourcing; followed by a more specific application to CustomerSourcing in particular. The value of such a model is to help web site developers identify the specific motivators for the potential site users; so that the motivators can be enhanced and supported – resulting in improved web sites with increased use and increased frequency of use.

Keywords: • CustomerSourcing • Crowdsourcing • Supply Chain • Value Chain • Intrinsic Motivation •

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1 Introduction

Conceptually, crowdsourcing is not a new concept at all. It is simply the process of calling upon the general public - the “crowd” – to contribute, by whatever method appropriate, to solving a business problem. In the 1700’s the Alkali Prize was established to solicit from the general public a less expensive method of producing sodium carbonate (Nesta, 2017). And in the 1800’s the Oxford English Dictionary asked the general public for new words which might be added to the dictionary (Brabham, 2013). Successful examples of crowdsourcing can be found throughout history; but the exponential growth of the concept did not begin until the Internet gave quick and easy access to the “crowd” – and particularly, the enabling characteristics of Web 2.0 (Tredinnick, 2006; DeVun, 2009; Chaordix, 2014).

Although the concept is nothing new, the term “Crowdsourcing” was coined as recently as 2006 when it appeared in a seminal article, “The Rise of Crowdsourcing” (Howe, 2006). Initially, Howe only described the phenomenon, without providing a succinct definition. After the ‘crowd’ had some time to explore and discuss the concept, Howe proposed a formal definition:

“Crowdsourcing is the act of taking a job traditionally performed by a designated agent (usually an employee) and outsourcing it to an undefined, generally large group of people in the form of an open call.” (Howe, 2008)

Capability and awareness are the two most important factors in Crowdsourcing. First, the Internet provides the capability of reaching and communicating with the crowd – the general public to which the open call is placed. Second, public awareness of the concept of CustomerSourcing as a new business tool (Horton & Chilton, 2010). As awareness quickly lead to popularity, a wide variety of sub-categories arose, each with varying purposes and characteristics. For example:

- CrowdFunding
- Cloud Labor (Macrowork and Microwork)
- Crowdvoting
- Crowdsearching
- Crowdsolving
- Crowdsourcing
- CrowdReviews
- CustomerSourcing

As a subcategory of crowdsourcing, CustomerSourcing is the focus of this article, as first described by Crane & Kitchens (2013). In particular, the focus will be on the intrinsic motivation which individuals have for participating in CustomerSourcing activities.

2 Rise of CustomerSourcing

Many traditional business processes have been altered with advancement of the Internet and e-business (Laudon, 2012); CustomerSourcing is one such example. It can be described as a modification from the traditional value chain and supply chain models; as described here.

2.1 Supply Chain Model

The supply chain model is traditionally depicted as a chain of business entities, one leading to the next, in a linear fashion. The supplier leads to the firm, which leads to the distributor, to the retailer, and finally to the customer (Kathawaia, 2003). This represents the flow of goods from raw materials to finished product, as depicted in Figure 1: Supply Chain Model.

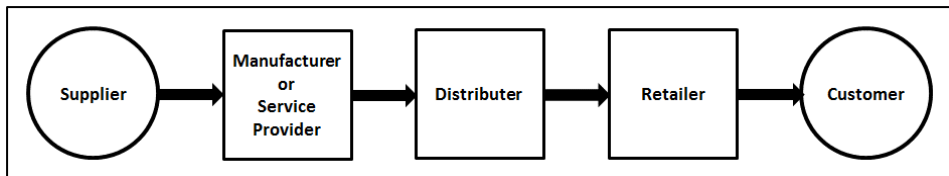


Figure 1: Supply Chain Model

2.2 Value Chain Model

The value chain model depicts the primary activities and support activities occur within a business unit (Porter, 1985). The activities included in the traditional value chain are depicted in Figure 2: Value Chain Activities.

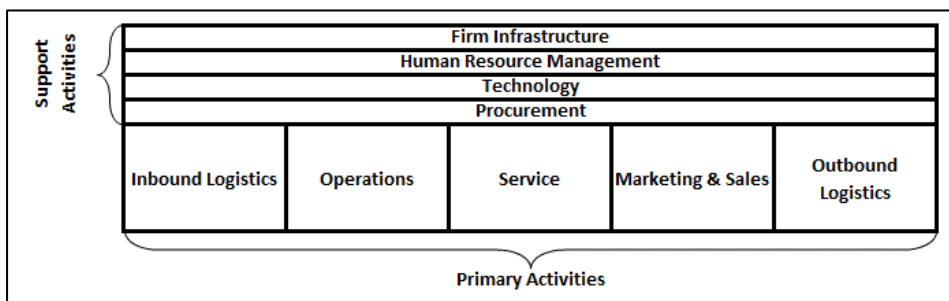


Figure 2: Value Chain Activities (Porter, 1985)

The effect of the Internet and disintermediation has, in many cases, caused the elimination of the middle-man (Pinto, 2000). Thus, by eliminating the Distributor and retailer from the supply chain model, and by inserting the value chain model in place of the manufacturer/service provider, the resulting new model depicts the customer, a business

unit with related activities, and the customer; as depicted in Figure 3: Disintermediation and the Merger of Value Chain with the Supply Chain Model.

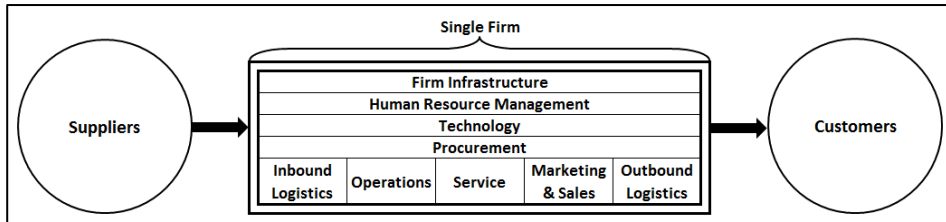


Figure 3: Disintermediation and the Merger of Value Chain with the Supply Chain Model

In the realm of e-commerce, all of the traditional functions of the supply chain continue to exist; but the individual firms have been disintermediated. The result is fewer middlemen; perhaps reduced to a single entity providing the services of the entire supply chain. This single firm is then collecting the resources from suppliers, performing some operation on the material to produce a product or service, and supplying the end product to the customer.

In the case of Crowdsourcing, the “suppliers” may actually be the “crowd.” The resources generated from the crowd-suppliers could conceivably be anything. Recalling a few of the various sub-categories of crowdsourcing reveals the wide variety of CustomerSourced resources available to a firm:

- CrowdFunding could generate operating capital
- Cloud Labor (also known as Macrowork and Microwork) could provide some of the necessary labor which is needed to run the firm or produce the output – any of the primary or support activities could be performed by crowd labor
- CrowdReviews could provide suggestions for product or service improvement
- Crowdsolving might replace a research and development team

In short, recalling Howe’s (2008) definition of crowdsourcing, a significant portion of the activities found in the Value Chain Model could be, ‘outsourced to a group of people in the form of an open call.’

The combination of disintermediation and crowdsourcing has created a new landscape in e-commerce. What is even more remarkable is the advent of a particular category of crowdsourcing, called CustomerSourcing.

2.3 CustomerSourcing

CustomerSourcing is a unique category of crowdsourcing in which the customers are also serving in the model as the suppliers. The resources which are being provided by the suppliers are actually coming from the customers themselves (Crane & Kitchens, 2013). Perhaps the easiest resource to supply in an e-commerce model would be data. There are many examples of situations where data is supplied to a firm; in which the firm processes the data in some way, and provides it back to the customers.

Examples of CustomerSourcing abound. In the most pure form of CustomerSourcing, the customer-suppliers are a closed group; all customers are suppliers, and there are no suppliers who are not customers. A popular example of this situation is found in online-dating sites (Kitchens & Crane, 2014). In this situation the potential customer is required to create an account and upload certain data describing themselves before they are allowed to download any information about other people who might be potential dates. Thus, the customer is forced to first become a supplier, before they may become a consumer of the online-dating site’s services.

There are other situations, where the customer-suppliers are not necessarily an exclusive group. Customers might be “potential suppliers;” or suppliers might have an interest in improving the output, but may never choose to consume the resulting output themselves. The social networking industry is built on this concept. Facebook, for example, is the largest social networking site in the world with 1.1 Billion unique monthly visitors (eBiz, 2017). They allow anyone to browse a limited portion of their content (the “public profiles”). To see more content, a potential customer is required to create an account and befriend other customers. This model is depicted in Figure 4: CustomerSourcing Model.

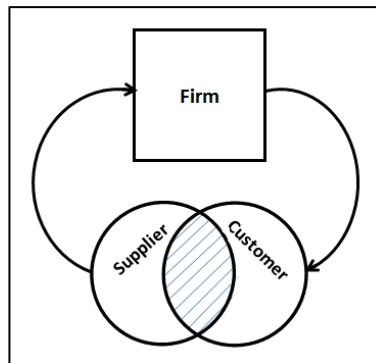


Figure 4: CustomerSourcing Model

3 Motivation

The financial aspect of CustomerSourcing has been explored by Kitchens & Crane (2014); in which the customer-supplier participants were found to fall into 3 broad categories: those with net income, those who broke even, and those who experienced a net outflow. The prospects of breaking even, let alone volunteering to knowingly experience a net financial outflow, gave rise to the question of motivation. Specifically, why do the customer-suppliers participate in an endeavour in which they know they will experience no financial benefit, or will result in a net financial loss? In addition, if these situations harbour ulterior incentives, then perhaps the prospect of financial gain is not the only incentive in the net income category. It has been shown that the motivation for individuals engaged in crowdsourcing can be a mix of intrinsic and extrinsic factors (Aparicio, 2012).

3.1 Intrinsic Motivation

Traditionally, intrinsic and extrinsic motivation were thought to be mutually exclusive categories of motivation. The more contemporary view is that these exist as to distinct types of motivation which create a continuum (Vallerand, 1993). While multiple motivators may exist simultaneously, the strength of each motivator may vary from person to person, and from task to task (Aitamurto, 2015; Aitamurto, 2016; Brabham, 2008; Brabham, 2010; Kaufmann, 2011; Brabham, 2012).

While financial incentive is one possible motivator on the extrinsic end of the motivation continuum, it may not be the only motivator (extrinsic or intrinsic). On the other end of the continuum, intrinsic motivation can be categorized into sixteen basic desires (Grabmeier, 2000; Riess, 2002). The sixteen categories of intrinsic motivation are:

- Acceptance, the need for approval
- Curiosity, the need to learn
- Eating, the need for food
- Family, the need to raise children
- Honor, the need to be loyal to the traditional values of one's clan/ethnic group
- Idealism, the need for social justice
- Independence, the need for individuality
- Order, the need for organized, stable, predictable environments
- Physical activity, the need for exercise
- Power, the need for influence of will
- Romance, the need for sex and for beauty
- Saving, the need to collect
- Social contact, the need for friends (peer relationships)
- Social status, the need for social standing/importance
- Tranquillity, the need to be safe
- Vengeance, the need to strike back and to compete

3.1.1 Crowdsourcing and Intrinsic Motivation

Using these categories, it is possible to classify the major motivators for each of the main crowdsourcing sub-categories. Crowdfunding for example is where the crowd provides financial resources for anything from business start-ups to study-abroad trips for students. Crowdfunding could provide multiple forms of intrinsic motivators. Selecting from the list of 16 intrinsic motivators (Grabmeier, 2000; Riess, 2002), those that most likely apply to Crowdfunding are:

- Honor: such as the satisfaction of supporting a family member studying abroad
- Curiosity: the opportunity to learn more about a new invention, possibly even being one of the first to own a prototype
- Idealism: the opportunity to aid in correcting social justice by supporting an underdog
- Saving: the chance to add to a collection in exchange for a financial contribution
- Social Status: the chance to be a major (or first) investor in a promising start-up business

The classification of forms of crowdsourcing into the 16 forms of intrinsic motivation can be performed for every category. Figure 5: Crowdsourcing and Intrinsic Motivation depicts the classifications for some of the most common forms of crowdsourcing.

		Intrinsic Motivation															
		Acceptance	Eating	Honor	Independence	Physical activity	Romance	Social contact	Tranquillity	Curiosity	Family	Idealism	Order	Power	Saving	Social status	Vengeance
Form of Crowdsourcing	CrowdFunding			X					X	X				X	X		
	Cloud Labor				X				X								
	Crowdvoting									X		X					
	Crowdsearching					X		X	X		X	X				X	
	CrowdReviews		X								X	X	X				
	Crowdsolving	X		X				x			X	X				X	

Figure 5: Crowdsourcing and Intrinsic Motivation

3.1.2 CustomerSourcing and Intrinsic Motivation

Focusing specifically on the CustomerSourcing form of Crowdsourcing, it is easy to imagine how each CustomerSourcing site might embody a specific set of intrinsic motivators. Even within the same industry, specific sites may have differing sets of motivators. For example, within the social media industry, two of the leading sites are

FaceBook and LinkedIn. Each has a different purpose and a different audience. This leads to different sets of motivators. FaceBook could have motivators such as:

- Acceptance: gaining the reassurance that friends and family approve of one's choice of holiday or new puppy
- Honor: expressing support for one's family or ethnic group
- Independence: an opportunity to express one's personal opinions or unique interests
- Romance: a place to express one's feelings for another
- Social Contact: an opportunity to accept invitations, offer invitations, and to reflect of social events
- Curiosity: a place where questions can be posed to friends and family, seeking approval or advice
- Idealism: an opportunity to express one's opinion in an effort to sway public opinion on a social cause
- Order: a place where individuals can provide explanation and structure for complex topics
- Power: while it is generally considered socially unacceptable; some have used Facebook as a platform for bullying
- Social Status: an outlet for the need to brag about oneself
- Vengeance: another motivator which is generally considered socially unacceptable; some have used FaceBook to launch social attacks on people or organizations

On the other hand, another social media platform, LinkedIn.com, provides a different set of motivators; as do each of the CustomerSourcing platforms. A sample of some of the most common forms of CustomerSourcing, with specific web sites for each, are depicted in Figure 6: CustomerSourcing and Intrinsic Motivation; with the corresponding potential motivators for each.

	Intrinsic Motivation															
	Acceptance	Eating	Honor	Independence	Physical activity	Romance	Social contact	Tranquility	Curiosity	Family	Idealism	Order	Power	Saving	Social status	Vengeance
Example of Customersourcing																
Social Media (FaceBook.com)	X		X	X		X	X		X		X	X	X		X	X
Social Media (LinkedIn.com)	X		X	X								X	X		X	
Product Reviews (Amazon.com)				X							X	X	X		X	X
Restaurant Reviews (TripAdvisor.com)		X				X					X	X	X		X	X
On-Line Dating (E-Harmony)	X		X	X	X	X	X	X	X	X		X			X	
Competitions (Threadless.com)	X			X				X							X	
Crowdsourcing (Trackr.com)					X		X		X			X				

Figure 6: CustomerSourcing and Intrinsic Motivation

4 Conclusions

Identification and classification of intrinsic motivation for crowdsourcing, and more specifically CustomerSourcing, websites is not an activity without consequence. Websites need users. In particular, CustomerSourcing web sites are vitally dependant on their customers as users in order to receive some form of supply for their Value Chain. Yet, some of these sites have no extrinsic benefit to the users – financial or otherwise. Studying these intrinsic factors is vitally important. Site developers need to identify the motivators, and create web sites which support and enhance the users' intrinsic motivators. The ultimate goal when a site relies on users for some of its value chain items is for an increased number of users, with increased frequency of visits.

Further research should seek to quantify the most important motivators which result in increased users and increased frequency of use.

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A First Step Towards Learning Analytics: Implementing an Experimental Learning Analytics Tool

JUSTIAN KNOBBOUT & ESTHER VAN DER STAPPEN

Abstract The educational domain is momentarily witnessing the emergence of learning analytics – a form of data analytics within educational institutes. Implementation of learning analytics tools, however, is not a trivial process. This research-in-progress focuses on the experimental implementation of a learning analytics tool in the virtual learning environment and educational processes of a case organization – a major Dutch university of applied sciences. The experiment is performed in two phases: the first phase led to insights in the dynamics associated with implementing such tool in a practical setting. The second – yet to be conducted – phase will provide insights in the use of pedagogical interventions based on learning analytics. In the first phase, several technical issues emerged, as well as the need to include more data (sources) in order to get a more complete picture of actual learning behavior. Moreover, self-selection bias is identified as a potential threat to future learning analytics endeavors when data collection and analysis requires learners to opt in.

Keywords: • Learning Analytics • Tool • Implementation • Experiment • Education •

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1 Introduction

Data analytics is already applied in many industries. The educational domain, however, has only recently started using data to improve its processes (Ferguson, 2012). Analytical activities aimed at improving education at a micro-level of educational institutes is called learning analytics: “the measurement, collection, analysis and reporting of data about learners and their contexts, for purposes of understanding and optimizing learning and the environment in which it occurs” (Long et al., 2011). Common research objectives include modelling student behavior in virtual learning environments and prediction of performance (Papamitsiou & Economides, 2014). The learning analytics process comprises four steps: 1) learners generate data, 2) these data are captured, collected and stored, 3) analysis and visualization of the data, and 4) the design and use of data-driven pedagogical interventions (Clow, 2012). The process is a cycle, as the effects of the interventions can again be measured, analyzed, visualized et cetera - see Figure 1.

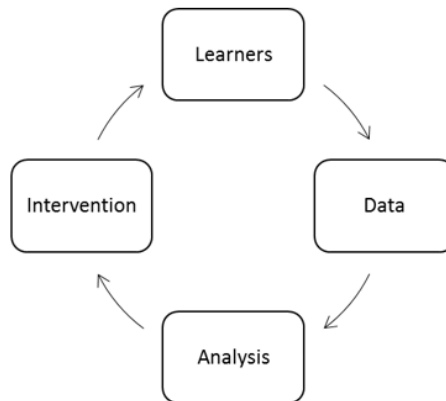


Figure 1: Learning Analytics Cycle (Clow, 2012)

Many examples of small-scale learning analytics initiatives exist (cf. MacFadyen & Dawson, 2010; Romero-Zaldivar et al., 2012; Lonn, Aguilar & Teasley, 2015; Fidalgo-Blanco et al., 2015). Our case organization, however, has only very limited experience with the application of learning analytics. To overcome this lack of experience, a learning analytics experiment is conducted. This study aims at identifying and understanding some of the dynamics associated with the implementation of learning analytics tools within the case organization and in educational institutes in general. Two research questions will be answered: 1) what issues are encountered when implementing an experimental learning analytics tool in the case organization’s virtual learning environment, and 2) in what way can the visualizations in the learning analytics teacher dashboard be used to design and perform timely pedagogical interventions? In this study, we will implement an externally developed learning analytics tool and research what barriers need to be overcome in order to apply the visualizations of the tool to education.

The remaining of this paper is structured as follows. First, the background of learning analytics processes and our experiment will be provided. We then elaborate on the primarily findings of the experiment conducted thus far. Finally, future work will be described.

2 Background

Higher educational institutes implementing learning analytics processes face several difficulties, e.g., changing existing information systems by implementing a learning records store (LRS) and customizing data streams (del Blanco et al., 2013); managing the increase in workload for teachers (Whale, Valenzuela & Fisher, 2013); and making sure all activities are in compliance with privacy legislation (Jisc, 2015). Greller & Drachsler (2012) provide a generic learning analytics framework with six critical dimensions to consider whilst setting up learning analytics services - see Figure 2.

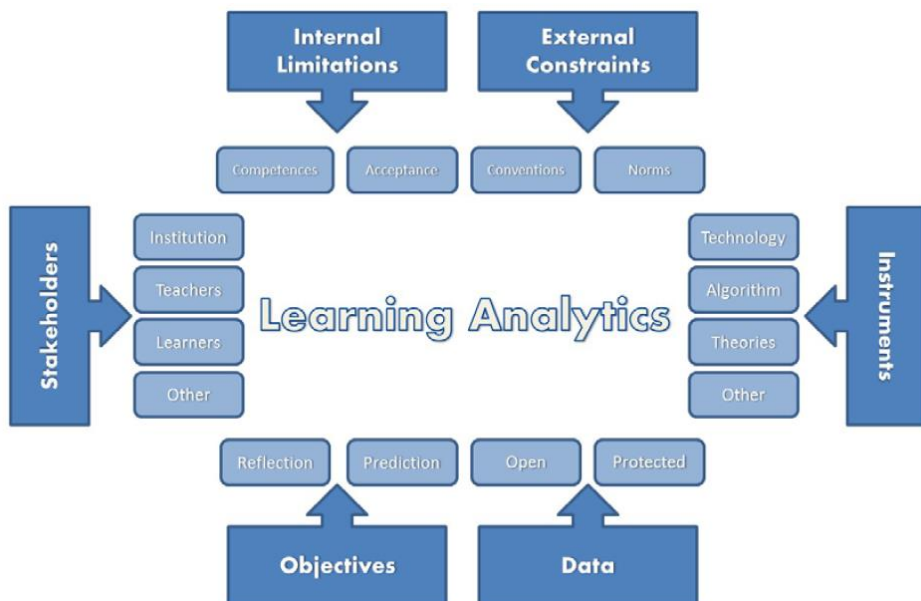


Figure 2: Learning Analytics Framework (Greller & Drachsler, 2012)

In order to help Dutch higher educational institutes overcome the aforementioned difficulties, SURFnet set up the learning analytics experiment (2016). The experiment provides all instruments – IT-architecture, data standard, algorithms – required to answer five pre-defined pedagogic questions. These questions are sourced from previous research aimed at identifying questions relevant for Dutch educators (Berg et al., 2016). Setting up the tool is relatively easy, as the only necessarily activities involve putting tracking codes on the pages and learning materials in the virtual learning environment.

Since the codes can easily be copy-pasted, only basic computer skills are required. Once placed, the codes allow data to be stored in a learning records store, from which the data can be analyzed and visualized in a dashboard. See Figure 3 for the learning analytics architecture and Figure 4 for the resulting dashboard as seen with a teachers' account. Teachers can see the anonymized activities of all learners in the experiment; learners have their individual dashboard and can view their own activities. To ease compliance with Dutch privacy laws, students must opt-in to allow their data being captured and analyzed.

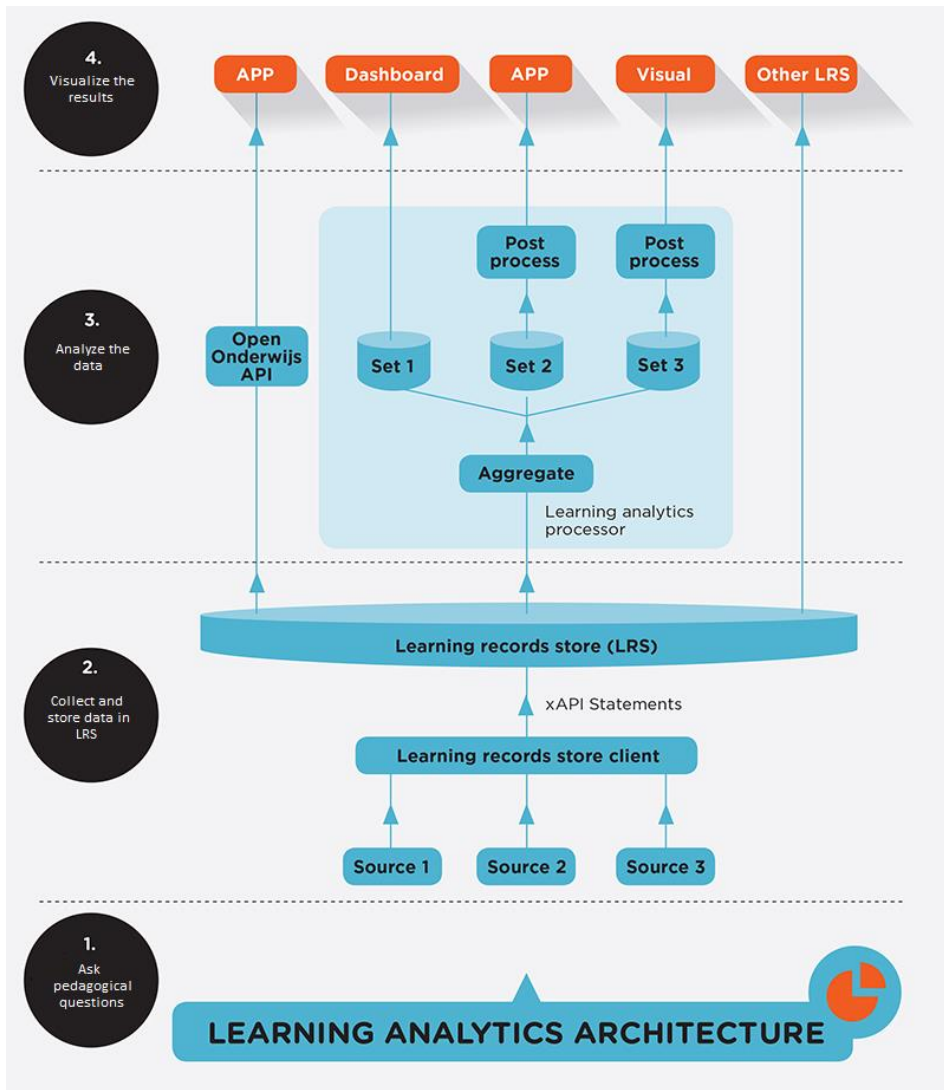


Figure 3: Learning Analytics Architecture (source: SURF, 2016)

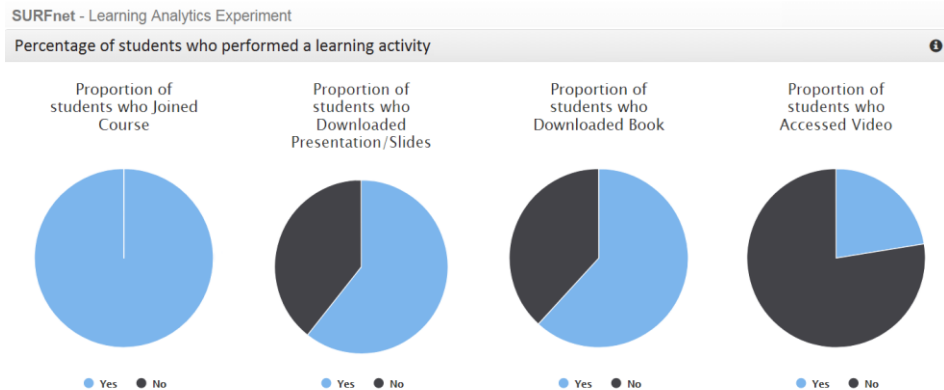


Figure 4: Dashboard As Seen With Teacher Account

Our case organization is a large university of applied sciences in the Netherlands. At two locations within the organization the Learning Analytics Experiment is conducted; at the Institute of Engineering and Design (IED) and at the Institute of Teacher Education (ITE). At IED, data is collected by tracking activities performed by first-year students of the Business Engineering undergraduate program enrolled in a statistics course. ITE, on the other hand, educates future secondary school English teachers - the experiment is here conducted in the courses Curriculum Design and ICT-rich Education.

3 Research objectives and method

The objective of this study is to research to what extent it is possible to perform learning analytics activities in the case organization’s virtual learning environment and what barriers are encountered when doing so (first phase of the experiment), and to research in what way pedagogical interventions can be designed and performed during the course by teachers based on the visualizations in the learning analytics dashboard (second phase of the experiment). We do this by answering the following research questions:

1. What issues are encountered when implementing an experimental learning analytics tool in the case organization’s virtual learning environment?
2. In what way can the visualizations in the learning analytics teacher dashboard be used to design and perform timely pedagogical interventions?

We use the framework of Greller & Drachsler (2012) to create a shareable description of context parameters for this learning analytics project. Below, we describe the first phase of the learning analytics experiment in Table 1. In the section Future Work of this paper, we will provide a description of the proposed second phase.

Table 1: Learning Analytics Experiment Case Description

Dimension	Value
Stakeholders	<i>Students</i> of two institutes of the case organization, participating in one of three courses (n=294). Three <i>lecturers</i> teaching the courses and actively involved in the experiment. SURFnet as external <i>facilitator</i> of the experiment. IT-department to allow SURFconext connection.
Objective	<i>Implementing</i> a learning analytics tool integrated in the organization's virtual learning environment.
Data	<i>Activities of students</i> in virtual learning environment, measured via the experimental tool.
Instruments	SURFnet's <i>Learning Analytics Architecture</i> , including teacher and student dashboards. <i>Virtual learning environment</i> of case organization.
External limitations	<i>Privacy laws</i> call students to opt-in for the experiment. <i>Connection</i> between case organization's and SURFnet's architecture.
Internal limitations	<i>Time</i> necessary to place tracking code on target pages and learning materials in the virtual learning environment.

After the first phase of the experiment, all involved teachers and researchers from SURFnet evaluated the process and outcomes during a focus group. Based on open observations, all experiences worth pointing out by the participants were discussed and notated. As all teachers involved encountered the same issues, consensus was reached fast. This led to the description of the preliminary results, as shown in the next section.

4 Preliminary results

The first round of the experiment resulted in several experiences and insights. In this section, we will elaborate on the most pressing results. First, an overview of encountered issues is provided. These are then categorized according to the dimensions of the learning analytics framework (Greller & Drachsler, 2012).

4.1 Technical issues

Although it is relatively easy to set up the tracking at the virtual learning environment, some technical issues arose. During the experiment, it became clear that not all activities were tracked. Root cause for this anomaly were the necessity to opt-in for the experiment; students who opted-in only provided permission to capture data from the specific device they used to subscribe. This results in incomplete datasets and renders extensive data

analysis useless. The causing issue has been resolved, so this problem will not appear in the second round of the experiment.

Another encountered technical issue relates to the SURFconext connection between the case organization's virtual learning environment and the SURFnet learning analytics dashboard. With SURFconext, it is possible for students to log in the learning analytics dashboard by using their own institutional username and password. This saves the need to create a new account. To establish the connection, the institutional SURFconext contact person must login his administrator account and provide permission to do so. At the beginning of the experiment, however, the connection was not allowed until only a few hours before the start of the courses. This almost led to cancellation of the experiment as the researchers did not want to confuse students with non-working dashboards and connections. This experience shows the need for institutional-broad support and cooperation in order to make learning analytics work.

4.2 Self-selection bias

Students need to opt-in for the experiment, allowing their data being captured and analyzed. Of the 234 Business Engineering students who enrolled in the course (both first-year students and students from later years wanting to retake the exam), 89 opted-in – only 38%. Similar proportions were found at the other institute. After the final exam of the course, the difference between the final grade of the students who participated in the experiment and those who did not were calculated using SPSS. Participants scored an average grade of 5.1 (sd = 2.2) and non-participants an average grade of 4.3 (sd = 2.3). An independent t-test shows there is a significant difference ($p = 0.032$) between the two groups and students who participated in the experiment scored on average better than those who did not. As no interventions were initiated based on the information in the dashboard, it is suspected that self-selection takes place. Future initiatives involving voluntary participation must account for this effect.

4.3 Need for more data

In order to perform effective interventions, rich data is required (Tempelaar et al., 2015; Conijn, 2016). In our experience, the current data is too poor to use for interventions. The lack of sufficient data can partly be traced back to the teachers who put too few tracking codes on their course page of the virtual learning environment. As one of the involved teachers puts it: “next time I will track everything: every page, every article and every video.” The experiment also relied on data from the virtual learning environment only. This provides only one side of the story - anecdotal observations of students using the online materials showed that they sometimes jointly sit together at a single computer to work on assignments, having the system only registering one student. Similarly, interaction between these students cannot be measured this way (Pardo & Kloos, 2011). In our experiment, data from other resources was not aggregated with the data in the learning records store. For example, the virtual learning environment provides students

the possibility to take quizzes. Quiz data (results, number of attempts, required amount of time to finish), however, are yet not stored and processed in the records store. In order to design and perform effective interventions, these data must be aggregated in future experiments.

4.4 Problem categorization based on learning analytics framework

In order to analyze which dimensions of the learning analytics framework (Greller & Drachsler, 2012) are causing problems during the implementation of the tool, we mapped the identified issues to the framework – see Table 2. This shows that four out of six dimensions faced difficulties so even though an almost ‘plug-and-play’ tool is provided, implementing it is a non-trivial endeavor.

Table 2: Problems Encountered per Dimension of Learning Analytics Framework

Dimension	Issues encountered
Stakeholders	Self-selection bias occurs as students need to opt-in for the experiment. IT-department not involved enough to collaborate fast on establishing external connection.
Objective	-
Data	Data on behavior in virtual learning environment alone do not provide enough insights to design effective pedagogical interventions. More data are needed in order to do so.
Instruments	The used tool was too limited in its data capturing. That is, not all activities were measured due to technical issues.
External limitations	Connection between case organization’s and SURFnet’s architecture only established at the very last moment.
Internal limitations	Teachers lacked insight in what learning resources to measure by placing tracking codes.

5 Future work

The experiment will be continued in the Fall of 2017. At the Institute for Engineering and Design, two courses will implement the learning analytics tool in their course design. One of the courses is taught to fulltime students, the other one to part-time students. This provides the opportunity to explore behavioral differences between participants of the two programs. Furthermore, to date, no interventions were performed based on the data analysis and visualizations in the experiment. Learning analytics research in general often focuses on data collection, management or how data will help to improve education but designing effective pedagogical interventions becomes a critical element (Wise, 2016). Now we have demonstrated the tool can be implemented in the case organization’s virtual

learning environment, we aim to use it for intervention design. This calls for extended requirements, as described in Table 3. The next phase of the experiment will continue the current work and focus on answering the question in what way the visualizations in the learning analytics teacher dashboard can be used to design and perform timely pedagogical interventions. That is, interventions should take place when it is still possible to make changes to the learning behavior, i.e., during the course. Both the practical experiences gained and the to-be performed interventions benefit practitioners from the educational domain as it provides first-hand insights in the dynamics involved with starting learning analytics activities.

Table 3: Future Learning Analytics Experiment Case Description

Dimension	Value
Stakeholders	<i>Students</i> participating in one of two courses. Six <i>lecturers</i> teaching the courses, two of them actively involved in the experiment. SURFnet as external <i>facilitator</i> of the experiment.
Objective	<i>Reflecting</i> on learning activities of students and performing pedagogical interventions based on (the lack of) these activities.
Data	<i>Activities of students</i> in virtual learning environment, measured via the experimental tool. <i>Formative assessment data</i> .
Instruments	SURFnet's <i>Learning Analytics Architecture</i> , including teacher and student dashboards. <i>(External) tools</i> to capture additional data, e.g., formative assessment data.
External limitations	<i>Privacy laws</i> call students to opt-in for the experiment. <i>Connection</i> between case organization's and SURFnet's architecture.
Internal limitations	<i>Time</i> necessary to place tracking code on target pages and learning materials in the virtual learning environment. The teachers doing so must <i>understand</i> what data are required for the interventions. <i>Competencies</i> related to effective intervention design are required, that is, teachers must understand the visualizations and are able to design and perform useful interventions based on it.

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Personalizing Narratives to Support Motivation for Physical Activity

OLLI KORHONEN, MICHAEL ODUOR & MINNA ISOMURSU

Abstract Technology supporting motivation for physical activity has been a common theme for researchers and companies during the last decade. Mobile devices and applications with diverse features provide novel and personalized ways to motivate users for healthier lifestyles. Features like goal orientation and self-monitoring are common for activity and emotion tracking applications, and lately there has been interest also in the use of narratives. Consequently, in this study we evaluate through a qualitative study how narratives are used to motivate physical activity. We analyze both user and system-specific characteristics using nexus analysis and conclude with three techniques for personalizing narratives.

Keywords: • Personalization • Narratives • Motivation • Physical Activity
• User Experience • Nexus Analysis •

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1 Introduction

Being physically active is not only beneficial for an individual, but also for the society (Kranz et al., 2013). Modern world health problems like obesity have become common (Campbell, Ngo and Fogarty, 2008; Consolvo et al., 2006) and people are facing difficulties in maintaining physical activity in their everyday lives (Consolvo et al., 2006) which emphasizes the possibility of encouraging more active lifestyles by changing individual exercise habits. Thus, it is evident that people should be encouraged and motivated to maintain their mobility behavior. In recent years, a number of mobile devices and applications that aim at supporting people in their athletic endeavors and other physical activities have emerged and these applications, with various tracking features, encourage people to exercise more (Ahtinen et al., 2008). These exercise applications provide opportunities for personalized health services, which make use of digital data in proactive and personalized ways (Häkkinen et al., 2015).

In this study, we examine the use of narratives in motivating users to engage in physical activity. We collected data using participatory observation, a focus-group, and semi-structured interviews, after which we analyzed users' reasons and motivations for exercising and use of the exercising application applying a nexus analysis (Scollon, 2004) approach. With nexus analysis, the aim is to deepen the understanding of the qualitative data collected (Molin-Juustila et al., 2015). The concept of user experience is widely applied in the fields of human-computer interaction (HCI) and interaction design and it is used for collecting subjective experiences, comprising the interaction between people and products (Forlizzi and Battarbee, 2004). By analyzing these experiences, we search for techniques for personalizing narratives. Our research increases the understanding of narratives as a motivational strategy and their impact on individuals' motivation.

2 Related Work

As modern life has increasingly been intertwined with digital technology, leisure activities are an important arena that have seen a lot of digitalization (Eklund, 2015). In recent years, for example, sports and overall wellbeing are topics receiving increased interest from research as well as from industry (Buttussi, Chittaro and Nadalutti, 2006). For this reason, both software developers and the general audience should be aware of the various ways of and the approaches to how people may be, are being, and will be influenced through the design of computer systems (Oinas-Kukkonen, 2013).

The HCI community has strived to promote wellbeing by developing applications and technologies that monitor and track users' activities. This has mainly been through use of theoretical frameworks derived from persuasion and social psychological theories, which make use of behavioral components like regular feedback and reminders to users in their physical activities (Maitland and Siek, 2009).

A related concept, gamification, the application of game design elements in non-game contexts (Deterding et al., 2011) has also become prevalent. Gamification can have a positive impact in health and wellbeing (Johnson, et al., 2016) and there have been increasing interests in using game principles in non-game contexts to make a challenging activity, such as exercising, more enjoyable and integrated into the users daily lives (Goh and Razikin, 2015).

One basic element in gaming are narratives. In gaming, narratives are used to structure games into logical series'. Unlike traditional narratives in movies, for example, which are linear and fixed, in games, players interact with the narratives, and the structure of the narratives is typically nonlinear (Qin, Patrick Rau and Salvendy, 2009).

Among the motivations for exercise is usually a discrepancy between the desired and actual lifestyle, and technology is used to support people towards a lifestyle they would like to lead (Consolvo, McDonald and Landay, 2009). Motivation is an essential feature in exercising as it highlights individual differences in behaviors when engaging in exercise (Patel and O'Kane, 2015). Using exercise applications is a complex mix of motivation towards exercising, satisfaction towards the application, external pressure, and actual effect of the usage of the application (Ahtinen et al., 2009).

In this study, we consider both intrinsic and extrinsic motivation (Vallerand and Losier, 1999). Intrinsic motivation refers to exercising for internal reasons like fun and pleasure. Extrinsic motivation emphasizes the role of external factors in motivating behavior. For example, exercising because of the expectation of a reward (Vallerand and Losier, 1999). Recently, motivational factors for exercising have been studied, for example, in the context of young adults doing physical activity (Capel et al., 2015). Capel et al. (2015), found that goal achievement, staying healthy, and social aspects were the key motivational factors for adolescents. More sustainable motivational factors have been studied by Fritz et al. (2014) where the authors interviewed users that had been using persuasive technology devices constantly for at least three months. The authors found that, routinized usage, integration to daily life, numerical feedback, and awareness of the value provided were the key factors that motivated users towards a more sustainable use of technology (Fritz et al., 2014).

3 Research Methodology

The research method applied in this study is nexus analysis (Scollon, 2004), a research strategy that uses discourse analysis and other methods well-suited for studying complex social action. In nexus analysis, each social action is thought to be mediated by the interaction order (relationships and power structures) among participants in a particular environment; the historical body–previous knowledge, experience, attitudes, and assumptions that the participants bring into the action; and, the discourses in place, that is, the discourses that are associated with or embedded in the scene of the action (Scollon,

2004). In this study, the concepts of historical body and interaction order are used in our analysis.

3.1 Study Context

The artefact under examination is *Zombies, Run!* *Zombies Run!* is an exercise application that is available for mobile devices through Google Play and Apple's App store. It is a running game with zombies as a survival story, is meant to be an immersive adventure, and "the game takes the player into a post-zombie-apocalypse world" (Southerton, 2013). The idea is to be outdoors as the application is story-based and at certain intervals, during the story, one is instructed to do certain things. Users can pick a mission before they start their run or follow a predefined series of missions culminating in an entire season.

The unique characteristics related to apocalyptic narratives make the game as a good example of a gamification-based application (Helf and Hlavacs, 2016). The application includes gamification elements such as, rewards, distance challenges, points, as well as supplies to be collected during the runs. Runs can be synced online and progress can be shared in various social media outlets like Facebook. *Zombies Run!* initially started as a premium service, but recently (in 2015) launched a freemium version—the basic application is free, but additional services and storylines that can improve the user experience come at a fee.

3.2 Data Collection and Analysis

Six participants were recruited for this study. All participants were female postgraduate students. We were interested in studying the users' motivational factors for exercising, usage of the application, and to examine the role of narratives in motivating exercise. According to their level of familiarity with the application, participants were categorized into two groups: Experienced and Inexperienced (Table 1) and were assigned aliases that will be used henceforth to represent them. Inexperienced users had minimal or no prior experience with the application, whereas experienced users had been using the application for at least 2 months.

Multiple qualitative data collection methods were used for achieving methodological triangulation. Data was collected using three different methods: 1) a focus group which was video recorded, 2) semi-structured interviews, and 3) participant observations, where participants were asked to think aloud and also video recorded during exercise. Data collection occurred between September and November 2015 and recruitment was mainly done using snowball sampling (Patton, 2005).

Table 1: Categorization of Participants and Data Collection

Participant	Experience level	Data collection
1. Abbey	Inexperienced	Participant observation and focus group
2. Becky	Experienced	Focus group
3. Carla	Experienced	Focus group
4. Debbie	Inexperienced	Participant observation and semi-structured interview
5. Ellen	Inexperienced	Semi-structured interview
6. Felicia	Experienced	Semi-structured interview

The focus group had 3 participants. One inexperienced user, Abbey and two experienced users, Becky and Carla. The focus group consisted of open-ended questions, starting from basic questions related to participants’ motivations for exercise and covering exercising habits, role of technology in exercising, hindrances towards exercise and their experiences of Zombies Run! Following the focus group, participant observation (video recorded) while using the application and three semi-structured interviews, each lasting 40-60 minutes, were conducted. Interviews consisted of similar questions to those in the focus group, and the aim of recording was to capture users’ authentic feelings and user experiences when using the application.

Interviews were transcribed and the data was analyzed using NVivo11 software. Data analysis process was twofold: first we identified, and categorized general discourses regarding motivations for exercising, and the role of narratives (and other application features) in exercising. Second, the concepts of interaction order and historical body (Scollon, 2004) were applied, in order to understand the motivations and the role of narratives more clearly.

4 Results

Generally, all participants had positive thoughts about exercising, but some of them pointed out the need for extra motivation, which could be provided, for example, by exercise applications.

4.1 Historical Body

Historical body refers to an individuals’ background, experiences, beliefs and practices, which may influence their view of and interactions with different media (Scollon, 2004). Abbey, Debbie and Ellen (inexperienced users) had not used the application prior to the study, whereas Becky, Carla and Felicia (experienced users) had. Two of three experienced users participated in the focus group and one in a semi-structured interview.

Abbey regularly went to the gym, went jogging, and also walked. Due to her already active lifestyle, she felt that she did not need any extra motivation to exercise (or to use the application). As she had used other activity tracking applications, she was clear on what she expected from such applications. Narratives were not, for her, a compelling

reason to use the application. Debbie was video recorded while jogging and participated in a semi-structured interview. She stated that she was physically active and exercised regularly, but at times finding time to exercise was a problem. Debbie also occasionally used activity tracking applications. Ellen participated in a semi-structured interview. She used to exercise in various (playing floorball, participating in group exercises, jogging) ways but the frequency had been decreasing due to tight time schedules and difficulties in starting to exercise again.

Becky participated in a focus group. She had been using the application for about half a year and prior to that she hardly exercised. The main reason for using the application was because it was different and she needed something interesting to get her to exercise regularly. The role of narratives was very important in her decision to purchase the application, as can be seen in the following quote:

“I bought it (the application) because it is geeky and fun, and it sounded more interesting than other running apps” (Becky).

Carla had been using the application for a longer period of time. She enjoyed the zombie genre and liked listening to the narratives. Prior to using the application, she was not very active and she stated that the application helped her to improve her exercise habits. The narratives and pre-set goals motivated her to exercise more because she saw pre-set goals as challenges that had to be completed, which she was incrementally able to do as illustrated by the comments below:

“The 5k which I tried first is perfect for anyone who has not been running, but wants to start. You start with really small steps and in the first parts you just run for 30 seconds or something” (Carla).

“It really improved my running a lot. I would say, within six months. In the beginning I would run for five kilometers, and after six months I could run twenty, so there is a big difference” (Carla).

Felicia participated in a semi-structured interview. She stated that she was physically active but finds it difficult to be consistent. Her motivation to exercise was related to wellbeing as exercising made her feel more energetic. Felicia mostly exercised alone because she wanted to focus on only that when doing it. The quote below illustrates this:

“I like exercising alone. For example, if I go to gym, I try to go there as late or as early as I can, so that there is no one else. Also when running, I prefer to run alone” (Felicia).

4.2 Interaction Order

Interaction order is about how relationships and technical affordances (if within a technical environment) affect people’s interaction. The interaction order entails studying how mediated actions occur: whether alone, in groups, the time, what precedes or triggers

an activity and so on (Scollon, 2004). The different kinds of (social) interactions that can take place are supported or encouraged by different design/feature implementations and these in turn control or limit users' actions.

Other than supporting the primary intent, which is jogging, in *Zombies Run!*, there are game-like features where users collect various supplies that help protect from a zombie attack and can be used to rebuild one's virtual town. Users can also share information about their exercises via social media channels or via *Runkeeper* that offers more social features than *Zombies Run!*

Abbey felt that the narratives in the missions were a distraction and they could be shorter. Although the narrative and game-like features are what initially attracted her to the application, Becky felt that they were not an integral part of the running experience. After using the application for a while, Carla and Felicia also stated that the narratives could be improved on by making them shorter or by reducing the time in between stories. There are long pauses in the stories when running that make it difficult to continually concentrate on a mission because one's focus is, every now and then, shifted away from a particular mission. Carla needed a distraction from the narratives because of the long pauses, and according to Abbey, the option of listening to music during the breaks in the mission was even more of a distraction as one had to switch between "two states of mind"—the joy provided by the music and the concentration needed in the mission. Abbey and Carla also felt that social features were not important for enhancing their experience of engagement with the application. Becky, on the other hand, felt that social elements were important and a key feature needed to give her that extra motivation to exercise. For Ellen, a lack of actual interactivity in the stories negatively affected her experience with the application. All the participants felt that the virtual rewards did not add any value or interactivity to a mission and the running experience would have been the same with or without them. Debbie, and Ellen felt that it would have been much better if collecting or winning something in the mission would have been linked to a physical activity. For example, in order to win a first-aid-kit, one had to either increase their speed or do jumping jacks that were directly linked to the item collected.

5 Personalization of Narratives

Nexus analytic concepts of historical body (life histories and experiences of the participants), and interaction order (relationships between participants engaged in social action) (Scollon, 2004; Molin-Juustila et al., 2015) enabled us to study narratives as a motivational feature. Instead of a generic narrative, narrative adaptation is one method for personalized gaming (Bakkes, Tan and Pisan, 2012). Personalized narratives are related to interactive storytelling, where the game content is personalized according to user preferences (Bostan and Marsh, 2010). We thus agree with Göbel et al (2010) that it is not feasible to create a narrative for each individual user. Therefore, based on our analysis, we propose three different narrative personalization techniques in the form of use cases.

5.1 Personalizing Narratives for Goal Achievement

This technique proposes that narratives are personalized based on users' goals. Once the user sets a personal goal, narratives are personalized to support the achievement of that goal. By monitoring users, the system identifies that achieving a personal goal requires a longer run, for example, and by personalizing the narrative, the system systematically persuades users to achieve their goals. The following quotes present some of the user goals:

“You have a certain goal for every exercise you do, and that gives structure to your exercise. I think that is one of the most motivating things for me. To have a certain specific goal” (Ellen).

“As for me, I think what I find motivating about running is the improving, getting faster, going further” (Becky).

“That is one motivation. Losing a little weight” (Felicia).

“...I have run for twenty-five minutes this week even though last week I could only run for fifteen minutes. The number of kilometers I have been running is more related to personal goals. Not that much of the goals set by the system” (Felicia).

Personal goals between users vary; some try to lose weight, whereas some want to improve in running. The following use case illustrates this narrative personalization technique:

A while back, Ellen was an active young woman but recently she has been demotivated and her husband constantly reminds her about her New Year's promise to exercise more. Previous sports applications supported her goal settings, but this application also provides narratives tailored to her goals.

Her goal is to lose weight and increase the distance she can run. After one month has passed, Ellen is not likely to achieve her goals. Therefore, the application adjusts the narratives to last for 60 instead of 40 minutes (length of basic episode). Goal setting is supported on many sports applications, but personalizing narratives to certain goals set by users is not that common. Once users set their goals, the system personalizes a narrative by either lengthening or shortening an episode to support the achievement of those goals.

5.2 Personalizing Gamification level of Narratives

This technique proposes that gamification level is personalized. Some users preferred to passively listen to the narratives without game elements, whereas others would have liked

more “playful” elements in the narratives, whether it was related to goal achievement, building a virtual base, or the integration of narratives into their surroundings:

“Application did not succeed in motivating me because it was not actually interactive at all. I was expecting some interactivity related to achieving my goals” (Ellen).

“In the game, base can be improved, but improving that base has no effect on the missions or how the story goes on” (Felicia).

“Because I wanted to experience something I started to ‘play the storyline’, like when I heard that bandages or whatever were picked, I started to pick some leaves fallen from the trees” (Debbie).

By personalizing gamification level, system could provide more (or less) gamification elements, tasks for users to complete for building the base, or provide “sub” missions that are integrated to certain locations and surroundings of the user. The following use case illustrates this technique:

Debbie has heard about *Zombies, Run!* from her friend Carla. Carla persuades her to try the applications and upon installing it, she is asked to set her location (Springfield) and level of gamification (high or low).

After a while, zombies are chasing her as she collects virtual bandages. Concurrently, in the narrative, there are facts integrated to Springfield, where zombies have captured the town hall. To rescue the town hall, she has to run intensively to the hall in order to expel the zombies. Debbie does this and she is rewarded by getting an extra town hall badge that can be used in her virtual base also.

5.3 Personalizing Genre or Intensity of Narratives

This technique proposes that the narrative genre is personalized based on users’ preferences. Some users were willing to have more intense storylines, whereas others preferred milder ones. The following quotes present the ideas of genre based personalization:

“You should have different storylines for other people as well, I could never imagine my mom going running with the zombies” (Abbey).

“There could be some adjusting in the storylines. You could for instance exclude the zombies or choose a different kind of narrative” (Carla).

As zombies are ‘the selling point’ in the application, excluding the theme fully may not be appropriate. However, letting users personalize the intensity/genre of a storyline, from scary to light, could attract a wider audience to the narratives. The following use case illustrates this technique:

Felicia, is a true zombie freak who has been organizing annual zombie parades in her local area. She was an early adopter of the application and now she is listening to the narratives again, but with a new scary-mode on. As she jogs, the zombies are ultra-aggressive, and she loves it. This is something she wants to show to her sister.

As her sister Abbey tries the scary-mode, she does not like it and quits right away. She blames Felicia for even suggesting her to try that. Felicia calms her sister down and lets her know that the intensity can be adjusted. Switching it from ‘scary’ to ‘light’ she persuades Abbey to try the application again. Abbey decides to go for a jog and instead of an avalanche of zombies, just a few zombies appear and, some of them are even having a “vegetarian picnic” in the park. She enjoys the mode and agrees that it provides a joyful experience.

Personalizing narratives for different genres can consist of different levels of storylines. Some can be scary and involve personalization based on the difficulty level (Bakkes et al., 2012), where the run could end up with ‘game over’, if ultra-aggressive zombies catch the user. Vice versa, on the lighter storylines zombies are not aggressive at all.

6 Concluding Remarks

Technology plays an important role in motivating people to exercise (Capel et al., 2015) and pervasive devices like smartphones can provide an accessible and personalized platform for applications supporting regular physical exercises (Kranz et al., 2013). In this study, the focus was on investigating the use of narratives as a motivational feature. Findings related to motivations and the role of technology are first discussed, and this is then followed by the use of narratives.

All participants exercised (some more than others) and had positive thoughts towards exercising. Although, their intentions to use exercise applications varied. Ahtinen et al. (2009) found that motivation to use exercise applications required both simultaneously enjoying to exercise and satisfaction with the application. In our study, not all participants were satisfied with the application’s features and its technical stability which negatively influenced their intentions to use the application in future.

Staying healthy, socializing, and achieving certain goals are key factors that motivate young adults to be active (Capel et al., 2015). Social sharing was found not to be a key motivator, which is consistent with findings in Ahtinen et al. (2008), as most of the participants did not want to/feel the need to share their exercise logs with other people or on online social platforms. The participants were primarily motivated to exercise for health reasons and even though some did not exercise consistently, they considered exercise to be an important part of their overall wellbeing. All participants found goal setting and data tracking as good motivators for exercise. Some users preferred setting goals themselves, and others used the system-set goals. The system-set goals were

considered by some to be challenging, whereas others felt that these goals did not match their own personal goals.

Gamification improves attitudes and enhances exercise (Goh and Razikin, 2015), and the gamification elements supporting goal setting and monitoring were appreciated by all participants. A recurring observation was that the gamified elements should better support the monitoring of pre-set or personalized goals, i.e. to better merge narrative elements of the application with individual's goals and their tracking.

Combining personalization strategies with persuasive systems rather than offering generic solutions has potential for better outcomes and can enhance users' experiences and achievement of their goals (Berkovsky, Freyne and Oinas-Kukkonen, 2012). However, support for personalization is still at a low level within these systems (Helf and Hlavacs, 2016). Personalizing narratives for each user may not be technically feasible (Göbel et al., 2010), but as users' motivations vary, personalization should be supported. In our study, three narrative personalization techniques were proposed to support users' motivation for physical activity.

The present study had a limited number of participants with relatively homogenous backgrounds. User experiences were collected using a focus group, participatory observation and semi-structured interviews. Our intention was not to focus on women only, but with snowball sampling, we ended up with such a homogenous user group. Furthermore, at the time we conducted the study, women were the most willing participants and not all of them were available to participate in all the data collection phases. Nevertheless, this provided us an opportunity to combine several qualitative data collection methods, and get detailed qualitative data, but sets limitations for the generalizability of the results as it was limited to a small group of Finnish users. Gender, age and cultural differences were also not considered in this study and therefore the findings cannot be assumed to be widely applicable to different contexts. With different application and users, results may differ. Nonetheless, the study highlights the importance of tailoring and personalization and presents ideas on how this can be done for different user groups.

In summary, technology for supporting motivation towards healthier lifestyles has remained a key topic in the fields of HCI and computer science. Development and evaluation of exercise applications with various features have been studied comprehensively. This study qualitatively analyzed the role of narratives to motivate people to exercise by using a nexus analytic approach. The focus was on user experiences related to an exercise application that utilized narratives to motivate users. Our study revealed that features like tracking and goal orientation did motivate users to exercise and so did narratives, however, their usage in wellbeing technology is still in its infancy. Personalization techniques have been used for setting personalized goals, or objectives, but in narratives, these techniques, are not widely studied. In this study, we have proposed three techniques (based on goals, gamification, and genre) for personalizing narratives.

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Serious Games in Healthcare: Results from a Systematic Mapping Study

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Abstract There is a need to understand, on a large scale, the role that serious games (SG) in healthcare can play in empowering citizens or patients. This systematic mapping study aims to identify how SG in healthcare is perceived and approached in the literature. A total of 408 studies from 2005-2016 were found, and after screening and exclusion, 83 studies were analysed. This study found that case studies with solution approaches that described design or development and literature reviews were the most popular methods used to analyse SG in healthcare. The biggest demographic groups targeted by SG that were described in these papers were children, the elderly, and patients with certain diseases. According to the results, the top five SG subjects in healthcare are education, exergaming, cognitive rehabilitation, psychology, and physical rehabilitation. The results suggest that the next focus will be on developing general guidelines for SG developers in healthcare, focusing on validation of SG and research of SG maturity models to improve level of development. Future studies should integrate the gaming industry and healthcare professionals.

Keywords: • Serious Games • SG • Health Games • Systematic Mapping Study •

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1 Introduction

The current study analysed how earlier studies have approached and presented serious games (SG) in healthcare. The term serious game, or applied game, is used to classify a game in which its main purpose is something other than pure entertainment (Djaouti, Alvarez, Jessel & Rampnoux, 2011; Susi, Johannesson & Backlund, 2007; Zyda, 2005). This group includes several subgroups, including edutainment, advergaming, edumarket games, political games, and training and simulation games, to educate, train, advertise, and influence people (Alvarez et al., 2007). Games can work as motivators or to help change players' behaviour (Baranowski et al., 2013; Ryan, Rigby & Przybylski, 2006).

Healthcare services are looking for new functions to empower their customers. SG in healthcare can provide methods for maintaining and developing health in different age groups. The goal can be to provide a new kind of model for self-help or rehabilitation. (Kempainen, Korhonen & Ravelin, 2014.)

Play and entertainment can be effective foundations for serious interventions in healthcare. Nevertheless, there is a need for more research studies that show a causal link between playing video games and health outcomes. (Kato, 2010.)

We wanted to understand how SG are seen by researchers. The main research question was:

How are serious games in healthcare perceived and approached in the literature?

To get the answer, three supplementary questions were presented:

- (RQ1) Which journals include papers on serious games in healthcare?
- (RQ2) What are the most investigated areas of serious games in the health sector and how have these changed over time?
- (RQ3) What research type and methods are most frequently applied?

A method of systematic mapping (Kitchenham & Charters, 2007) was selected for getting a broad overview of the chosen area. Systematic mapping study is a proper method to reveal whether there is research evidence on a topic, and to provide any indication of the quantity of evidence (Kitchenham & Charters, 2007). The guidelines provided by Petersen et al. (2008); Petersen, Vakkalanka, and Kuzniarz (2015); and Kitchenham, Budgen, and Brereton (2011) were applied. Existing criteria on research approaches given by Wieringa, Maiden, and Roland (2006) were utilised in the evaluation.

This paper presents a systematic mapping study of SG in healthcare and is organised into four major sections: background and related work on SG, research approach, mapping results, and conclusions.

2 Background and Related Work

The concept of serious games was introduced in the 1970s when it referred to an activity among two or more independent decision-makers seeking objectives in a limited context. In that time, SG were focused on educational functions (Ricciardi & De Paolis, 2014). The concept involves a digital game whose main purpose is something other than pure entertainment and is designed to be used in training, education, and healthcare (Loh, Sheng & Ifenthaler, 2015).

Zyda (2005) defined a serious game as:

a mental contest, played with a computer in accordance with specific rules that use entertainment to further government or corporate training, education, health, public policy, and strategic communication objectives (p.25).

Susi, Johannesson & Backlund (2007) defined SG as:

games that engage the user and contribute to the achievement of a defined purpose other than pure entertainment (whether or not the user is consciously aware of it) (p.5).

Fullerton (2014) described a digital game as a system in which the whole is greater than the sum of its parts. A digital game creates a structured conflict and provides an entertaining process for players to resolve that conflict (Fullerton, 2014). Game design combines psychological aspects (Rigby & Ryan, 2011) with mechanical and artistic aspects (Fullerton, 2014). Game designers empathise with players, and their main task is to ensure that the game will be entertaining (Adams, 2013.) Juul (2011) defined video game as a game played using computer power and a video display that can be a computer, cell phone, or console game. Video games not only can tell stories, but also allow players to live them (Rigby & Ryan, 2011). Figure 1 illustrates aspects of SG design.

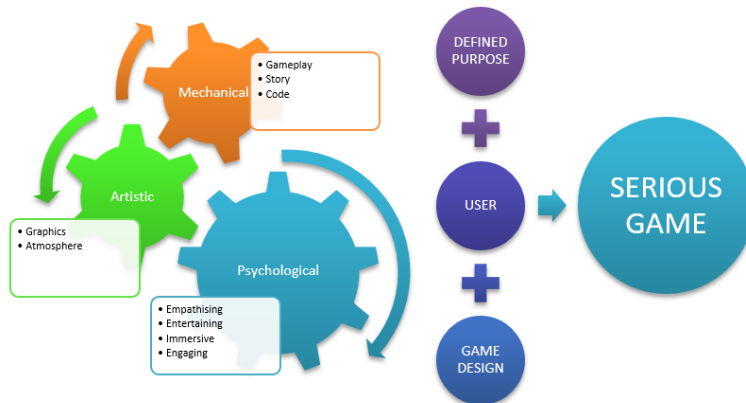


Figure 1: Aspects of Serious Game Design

Research on player motivation is founded on knowing what psychological needs games satisfy and how different games fulfil those needs, and immersion, in which a player is transported to a fictional world through storytelling is a valuable asset. This provides information about both positive and negative experiences within games. (Rigby & Ryan, 2011.) In the early 2000s, Rollings and Adams (2003, p.201) defined gameplay as ‘One or more causally linked series of challenges in a simulated environment’, and Adams (2013) later described gameplay as:

the challenges presented to players and the actions players are permitted to take, both to overcome those challenges and to perform other enjoyable activities in the game world (p.511).

The healthcare sector has strong interests in using new technologies related to health. SG in the health sector can be divided into game-based education of health professionals and improving therapeutic outcomes of patients. Today’s increasing challenges with aging populations and chronic diseases suggest that serious games in healthcare may be one strategy to help with survival (Arnab, Dunwell & Debattista, 2013).

Health games can be classified also by their main purpose, type of players, and the stage of disease of patients. The stages of disease of patients include stage of susceptibility (healthy non-patients with the possibility of certain illnesses), pre-symptomatic stage (patients feeling healthy with specific illness), stage of clinical disease (patients or professionals), or stage of recovery or disability (patients or professionals), as divided by Wattanasoontorn, Hernandez, and Sbert (2014), who indicated three main purposes for health games:

1. Games that are designed originally for entertainment and in which a health purpose comes secondary, but can be found in the games.

2. Games that include a health topic to pass on knowledge or skills.
3. Training games with medical purposes, including simulations.

The classifications by Wattanasoontorn et al. (2014) also divide health games by player, as in patient player (health monitoring, detection, treatment, rehabilitation, education for self-care) and non-patient player (wellness, simulation games). Furthermore, health games can be classified in the areas of physical fitness, education in health, training and simulation, rehabilitation (recovery, therapy), diagnosis and treatment of mental conditions, cognitive functioning and self-control (Susi et al., 2007). Figure 2 illustrates these classifications.



Figure 2: Classification of SG in healthcare (Wattanasoontorn et al., 2014; Susi et al., 2007)

There are many different stakeholders in the health-game market, such as hospitals, clinics, private-practice physicians (including therapists and personal trainers), government, corporations, other organizations, and individual consumers (Susi et al., 2007). Social Security systems and healthcare providers differ significantly among different countries and on a global scale, with each market area having its own methods to facilitate a healthy lifestyle (Kaleva, Hiltunen & Latva, 2013). Significant changes should be expected, for example, in medical simulations, serious games, and mobile serious games, and an increased need for serious-game analysis is already present (Loh et al., 2015).

Supporting players' motivations and enhancing behavioural changes are essential in health-game design (Rigby & Ryan, 2011). Design includes using game elements such as surprise and simulation to engage players and enable immersion (Adams, 2013). On the other hand, developing a health game requires a multi-disciplinary team to work together successfully (Kemppainen et al., 2014). It is important to define both the target group and main objective, then design a game accordingly using sound game-design principles in collaboration with health professionals and involving patients as early as possible (Brox, Fernandez-Luque & Tollefsen, 2011). Braad, Folkerts, and Jonker (2013) describe the health-game design process as a game-based intervention process. Their human-centred design method consists of four phases: analysis, design, development, and evaluation.

Like Braad et al. (2013), Friess, Kolas, and Knoch (2014) and Deen et al. (2014) use similar processes in SG development in the health sector. They all include strong research and analysis phases at the beginning, and involving different stakeholders is essential. Iterative development processes or the use of prototyping are among their development methods. The game-development process then ends usually with user-group testing and evaluation or validation phases.

In the design of SG in health games, the target group should be considered during the development process (Brox et al., 2011; Braad et al., 2013; Friess et al., 2014; Deen et al., 2014). A multi-disciplinary team is necessary to develop a successful and effective health game, and professional knowledge is an essential part of the development process (Kemppainen et al., 2014; Merry et al., 2012).

3 Research Approach

To get an overview of SG in healthcare studies, the guidelines for a systematic mapping process (presented in Chapter 3.1, Fig. 1) were followed. This chapter describes the chosen research method and how it was applied.

3.1 Overview of Systematic Mapping Study

A standard systematic literature review is usually conducted over a specific research question that can be answered by empirical research (Kitchenham et al., 2011). A mapping study, on the other hand, aims to provide an overview of a topic area through multiple research questions (Kitchenham et al., 2011). Mapping questions are about what we know with respect to a specified topic (Petersen et al., 2015). The results of a systematic mapping -- presented as a visual summary, the map -- help determine in which areas to conduct a conventional systematic literature review (Kitchenham et al., 2011; Petersen et al., 2008).

A systematic mapping process (Fig 3) defined by Petersen et al. (2008) consists of the following process steps: definition of research questions, conducting the search for

relevant papers, screening of papers, keywording using abstracts, and data extraction and mapping. The categories used in a mapping study are usually based on publication information such as authors' names, authors' affiliations, publication source, publication type, publication date, and/or information about the research methods used (Kitchenham et al., 2011).

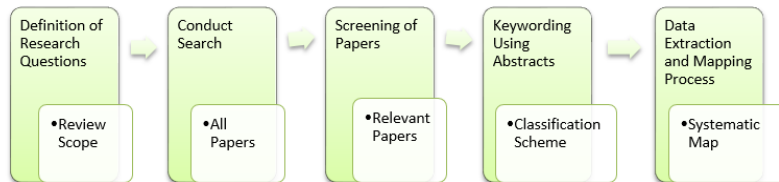


Figure 3: Systematic mapping process (Petersen et al., 2008).

Mapping questions often are formulated around what we know with respect to a specified topic and include questions regarding venues, research methods, and trends (Petersen et al., 2015). The search is conducted in relevant databases for all papers in the research field, and, as recommended by Kitchenham and Brereton (2013), the use of IEEE and ACM, as well as two indexing databases, is sufficient. A search string is defined based on the research questions (Petersen et al., 2008).

The third step in the systematic mapping process is the screening of papers. Inclusion and exclusion criteria are needed to find relevant papers that answer the research questions (Petersen et al., 2008). Inclusion and exclusion criteria can be related to the relevance of the topic of the article, venue of publication, period considered, requirements for evaluation, and restrictions with respect to language (Petersen et al., 2015). The selection of papers is performed on titles and abstracts, thereby building a classification scheme first, then later reading is extended to introductions and conclusions (Petersen et al., 2015).

For classifying the type of research, Kitchenham et al. (2011) and Petersen et al. (2008,2015) recommended using a classification system developed by Wieringa et al. (2006) with six categories:

1. Validation research, which concerns evaluating novel techniques not yet deployed in industry
2. Evaluation research, which concerns evaluating industrial practices
3. Solution proposals, which discuss new or revised techniques
4. Philosophical papers, which structure the field in new ways, such as taxonomies
5. Opinion papers
6. Experience papers, which discuss how someone did something in practice

In the data-extraction phase, relevant articles are sorted into a scheme, such as an Excel spreadsheet. The mapping process ends with a presentation on the frequencies of publications for each category using maps for visualization (Petersen et al., 2008).

3.2 Research Questions

To get a broad overview on how serious games in healthcare are perceived and approached in the literature, the following supplementary questions were asked:

- RQ1: Which journals include papers on serious games in healthcare?
- RQ2: What are the most investigated areas of serious games in the health sector and how have these changed over time?
- RQ3: What research types and methods are most frequently applied?

The objective of RQ1 was to identify the forums of discussion. The objective of RQ2 was to discover trends in research and possible gaps. The objective of RQ3 was to determine the methods of research used.

3.3 Search and Screening of Papers

To get a broad overview of the research area, searches were first conducted on these scientific databases: IEEE, ACM, Scopus, Web of Science, and Google Scholar. At the second stage, the database of Web of Science was left out of the process due to technical problems with remote access. The search string was formulated by considering the properties of each database.

Search string: Search for serious games in healthcare, i.e. ‘serious games’ OR ‘serious game’ OR ‘applied game’ AND ‘health’ OR ‘healthcare’ AND ‘design’ or ‘development’.

The search strings used for each database and number of search results per database are presented in Table 1. Without the design and development elements of the search parameters, the number of papers filtered out would have totaled 2,199.

Table 1: Search strings and number of results in databases

Databa se	IEEE	ACM	Scopus	Web of Science	Google Scholar	To tal
Search string Refined search to design, development	((('Document Title': 'Serious games' OR 'Document Title': 'serious game' OR 'Document Title': 'health game' OR 'Document Title': 'applied game') AND 'Document Title': 'health' AND (p_Title: 'development' OR 'Document Title': 'design'))	((('Serious games') OR ('serious game') OR ('health game') OR ('applied game')) AND (('development') OR ('design')) AND ((health) OR ('healthcare')))	TITLE-ABS-KEY('Serious games' OR 'serious game' OR 'health game' OR 'applied game' AND (('development') OR ('design')) AND (('health') OR ('healthcare'))) AND (LIMIT-TO(DOCTYPE, 'cp') OR LIMIT-TO(DOCTYPE, 'ar')) AND (LIMIT-TO(SUBJAREA, 'COMP') OR LIMIT-TO(SUBJAREA, 'ENGI')) AND (LIMIT-TO(LANGUAGE, 'English'))	((('Serious games') OR ('serious game') OR ('health game') OR ('applied game') OR ('development') OR ('applied game')) AND (('development') OR ('design')) AND ((health) OR ('healthcare')))	-	
	93	95	276	108	79	651

The following inclusion criteria were applied to titles in the screening of papers (reading through titles and abstracts):

- Topic of study focuses on serious games in healthcare.
- Studies are in the field of software engineering or information systems.

The following exclusion criteria were applied to titles in the screening of papers:

- Studies presenting summaries of conferences/editorials
- Studies presenting non-peer-reviewed material
- Studies not presented in English

- Studies not accessible in full text
- Books and grey literature.
- Studies that are duplicates of other studies.

This yielded a total of 479 papers, of which 71 were found to be duplicates, leading to a final total of 408 papers (see Table 2).

Table 2: Number of included papers.

Database	IEEE	ACM	Scopus	Web of Science	Google Scholar	Total
After screening of papers, exclusion of papers outside of focus area.	60	90	221	75	33	479
Duplicates						71
Total						408

3.4 Keywording and Study Selection

The basic information in papers, such as authors, titles, years published, source titles, abstracts, digital object identifiers (DOIs), and links were exported into an Excel spreadsheet. This table was used in keywording to find the classification scheme as follows: Abstracts from ACM, IEEE, and Scopus search results were downloaded as text from the Excel spreadsheet to TagCrowd (www.tagcrowd.com) to create an overview of used keywords in the filtered-out abstracts. These keywords are presented in Figure 4 to visualise the volumes of used words in the abstracts.

The classification schemes were formed based on the chosen keywords and included research articles. From these keywords and connecting the information with research questions, the following classification schemes were formed:

1. Source Title (RQ1)
2. Aim/target and focus (RQ2), Year (RQ2): using keywords such as behaviour change, cognitive, education/learning, rehabilitation, therapy, exergaming, design/development, user/patient, interaction, persuasive, usability
3. Research type: validation, evaluation, solution, philosophical, opinion, experience (RQ3), and research method (RQ3)



Figure 4: Frequencies of keywords/index terms.

The frequencies of keywords or index terms of ‘serious games in healthcare’ are presented in this order: ACM (upper left), IEEE (upper right), and Scopus (lower left) in Figure 4.

3.5 Data Extraction and Mapping Process

To answer research questions, the data was sorted on an Excel spreadsheet (data-extraction form) with basic identification information from papers such as identification number (ID), authors, titles, years published, source titles, DOIs, and links. The classification schemes were added: aim/target and focus, research type, and research method.

Since the search results totaled up to 408 papers, it was decided that RQ1 and, partly, RQ2 would be based on the whole body of articles. On the other hand, to be able to answer RQ2 and RQ3 required reading through papers and gathering needed information in classification schemes. It was decided that this would be done in publications that have 10 or more papers in each source publication, restricting the upper limit of read papers to 112. Each of these papers was read to find the above information, which was added to the spreadsheet. At this phase, 18 papers were considered to be not fully in the realm of health games and thus were excluded, and 11 were not available as full text, which brought the number of papers down to 83. If information was not available on the abstract, or the paper was not accessible in full text, it was excluded at this point. Papers were arranged in ascending order by publication time.

The analysis of the results focused on presenting the frequencies of publications for each category.

The quality of the sample of studies selected in the inclusion/exclusion process, generalizability of the results of the mapping, and reliability of the conclusions drawn in relation to the data collected were identified as possible threats to the validity of the research.

4 Analysis and Interpretation

This chapter is structured with the help of the assisting research questions.

4.1 Venues of Publication (RQ1)

To find out which journals include papers on SG in healthcare, the distribution of papers in different publications is visualised in Figure 5, and the publications that have 10 or more papers in each publication are listed in Table 3. The papers were published in 163 different publications, which indicates quite a vast distribution over different sectors; 93 publications included only one (1) paper in this area.

Table 3: SG in Healthcare publications with 10 or more papers.

Name of Publication	Number of Papers
IEEE International Conference on Serious Games and Applications for Health (SeGAH)	41
Lecture Notes in Computer Science (including subseries Lecture Notes in Artificial Intelligence and Lecture Notes in Bioinformatics)	31
International Conference on Pervasive Computing Technologies for Healthcare	15
Studies in Health Technology and Informatics	15
Games for Health Journal	10
Total	112

The most popular publication was IEEE SeGAH Conference, with 41 papers, the Lecture Notes in Computer Science came in second, with 31 papers. The research area of SG in healthcare covered many research disciplines. Most of the papers were from conferences.

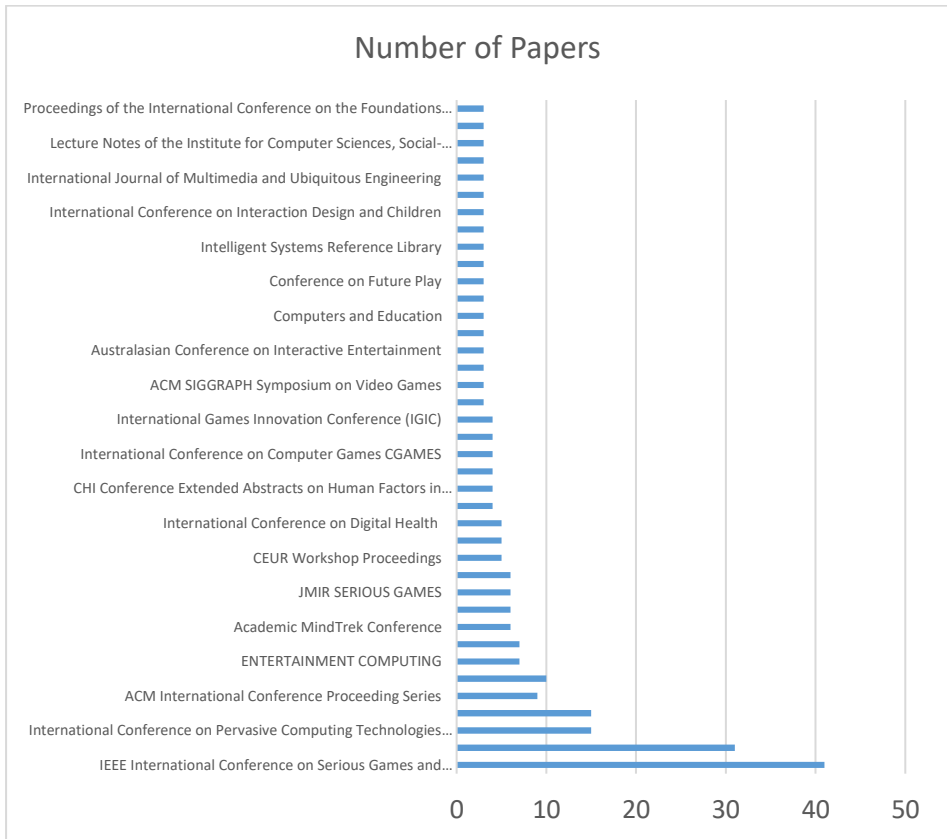


Figure 5: SG in Healthcare source publications and number of articles with three or more papers.

4.2 Topics and Frequency of Publication (RQ2)

To analyse the annual distribution of SG articles in healthcare, the annual distribution was calculated between the years 2005 and 2016. Some of the papers were published in 2017, but those were excluded due to the scheduling of the study. Figure 6 shows the number of papers over the years, and the trend has been increasing until 2014. After that, there was a gap in 2015, and it went back up to 82 in 2016.



Figure 6: Number of papers on SG in healthcare between 2005 and 2016.

According to a content analysis of 83 papers, the most investigated areas of serious games in the healthcare sector regarding games' aims are presented in Figure 7. The five top subjects of serious games were:

- Education (14)
- Exergaming (8)
- Cognitive rehabilitation (6)
- Psychology (6) and
- Rehabilitation (6)

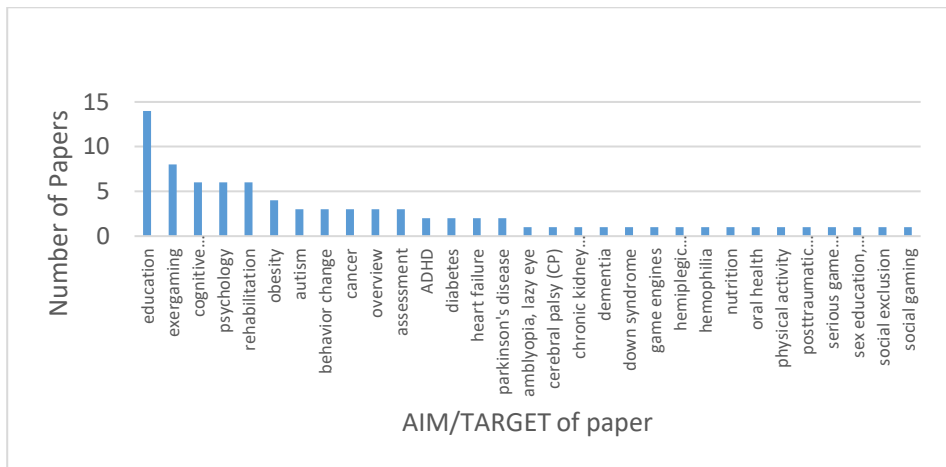


Figure 7: Number of papers according to aim/target of the serious game.

Most of the papers focus on describing design and development of a serious game (28). The next most popular focus areas were user-centred design (6) and participatory design (5). This is presented in Figure 8.

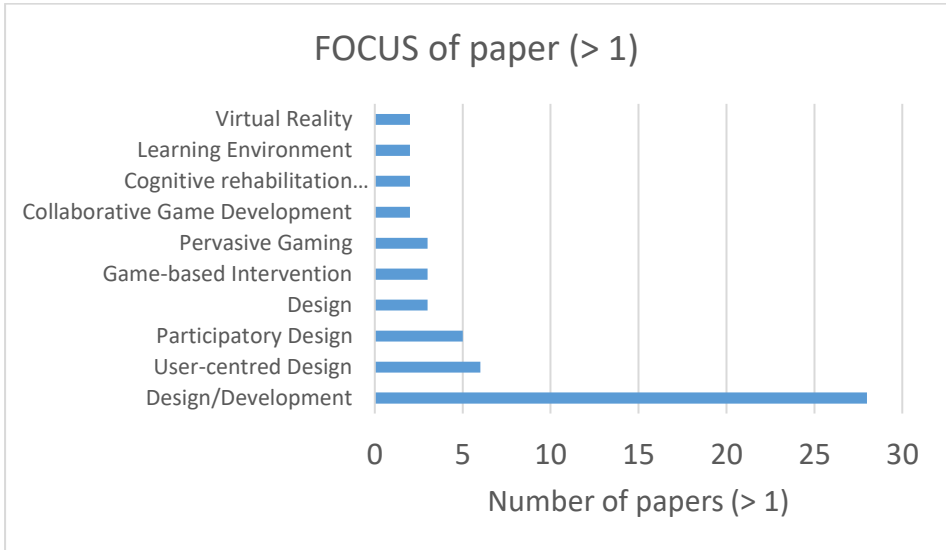


Figure 8: Number of papers grouped by focus of the paper.

One way to categorise the most investigated areas of health care was to analyse the target group of developed games. As illustrated in Figure 9, the targeted demographic groups of most serious games in these papers were children (20), the elderly (15), and patients of certain diseases (8).

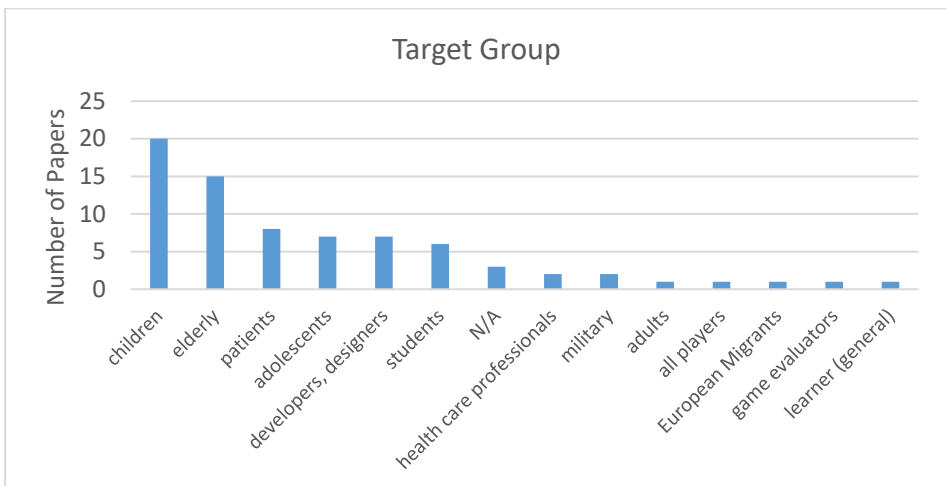


Figure 9: Number of papers according to target group.

4.3 Research Types and Methods (RQ3)

To analyse the research type and methods, the papers were categorised according to the research types in the classification system by Wieringa et al. (2006). None of the analysed papers were considered Opinion or Experience research. 55% of them were categorised as Solution Research, 19% Philosophical, 15% Validation, and 11% Evaluation Research, which is presented in Figure 10.

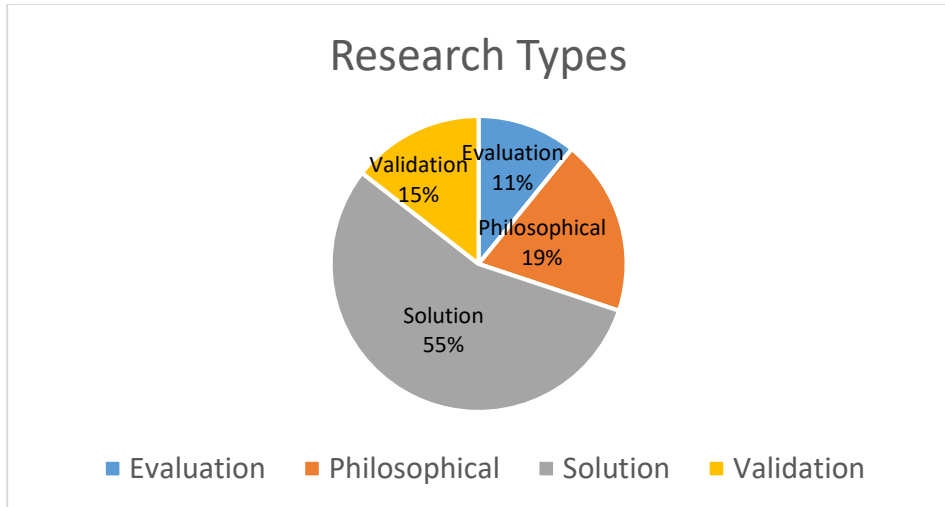


Figure 10: Research type in papers.

Research methods in analysed papers are presented in Figure 11. Most of the papers were classified under case studies and literature reviews/studies.

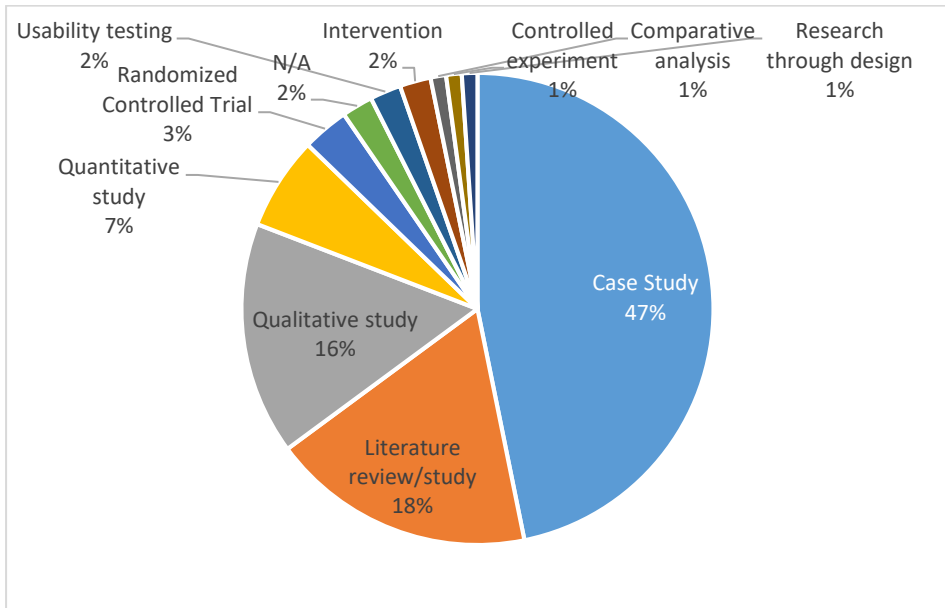


Figure 11: Research methods of papers.

5 Conclusions

The purpose of the study was to analyse how SG in healthcare are perceived and approached in the literature. To solve the research problem, systematic literature mapping was applied in the study. A total of 408 studies from 2005-2016 were found, and after screening and exclusion, 83 studies were analysed. The results of this systematic mapping could be used to identify gap areas in research of SG in healthcare.

Although the concept of serious games is from the 1970s (Ricciardi & De Paolis, 2014), we found out that there were just a few publications who wrote about the phenomenon before 2009. The number of publications increased until 2014, after which there was a gap in 2015, then the number increased again in 2016. Most of the analysed papers came from conferences. The most popular forum of discussion was the IEEE SeGAH conference, with the Lecture Notes in Computer Science coming in second. Since the development of SG in healthcare is multi-disciplinary (Kempainen et al., 2014; Merry et al., 2012), some of these papers were published in medical journals and thus were not included in this study.

Wattanasoontorn et al. (2014) classified health games by their main purpose, types of players, and patients' stage of disease. The biggest target groups of SG described in this mapping study were children, the elderly and patients with certain diseases. In the analysed studies, the main purpose and type of player were easily found, but none used classifications for stages of disease. The five top topics of SG in healthcare were

education, exergaming, cognitive rehabilitation, psychology, and physical rehabilitation. In educational games, the players were 1) healthy people (informative, preventive approach) of a certain group: children, adolescents, the elderly, etc. 2) patients with certain diseases (informative, educative) or 3) students and professionals in a certain medical area (educative, training, or simulation).

Considering the focus and methods of research, the most common approach was to describe design or development of SG by using a case study. Most of these were considered solution proposals as defined by Wieringa et al., thereby discussing new or revised techniques. The focus of most studies was in using user-centred, participatory, and collaborative design models. This supports prior research involving different stakeholders in SG development (Brox et al., 2011; Braad et al., 2013; Friess et al., 2014; Deen et al., 2014). Also, there were some literature reviews that were deemed to be philosophical papers, structuring the research field in new ways. Kato (2010) brought up the need for validation of SG in healthcare, but it was not seen as a topic in many papers. One RCT and a controlled experiment were found, as well as a couple of intervention studies. Few papers covered guidelines for assessment of SG. Many described prototypes of SG were tested with focus groups, but there were no further studies found. There were just a few papers focusing generally on SG design or providing guidelines for SG developers in healthcare, even though there were plenty of cases described.

The study unearthed new knowledge on the topic of how serious games in healthcare are perceived and approached in the literature. The results provide a foundation for deeper analysis of the use of SG in the health sector, and suggest that the next focus will be on developing general guidelines for SG developers in healthcare, focusing on validation of SG and research of SG maturity models to improve level of development.

The study points to future avenues of research integrating both the gaming industry and healthcare professionals. There are limitations to the study of research mapping, and further studies should be conducted to validate and further extend the knowledge of SG in healthcare.

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Designing an IoT-enabled Gamification Application for Energy Conservation at the Workplace: Exploring Personal and Contextual Characteristics

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Abstract This paper focuses on determining the important factors that must be considered when designing and developing a gamification application that educates employees in workplaces, towards a more sustainable energy consumption behaviour. We have conducted on-site surveys, as well as unstructured interviews with employees from three different workplaces where we will deploy the app. We present our key findings and propose specific insight and guidelines for experiments aiming towards energy conservation at the workplace through behavioural change. We conclude that the individual contextual characteristics of workplaces lead to the availability of different energy conservation behaviours that can be acted upon by the employees. At the same time, the employees' preferences for the gamified app include, among others, a collaborative game scenario – that features both intrinsic as well as extrinsic rewards based on the individual participant profile. This research is conducted in the course of a H2020 EU funded project, through which an IoT-enabled energy monitoring platform for workplaces will be developed, with the ultimate goal to change the employees' energy consumption behaviour through a gamification application.

Keywords: • Energy Conservation • Gamification • Workplace • Employee Behaviour •

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1 Introduction

Commercial and industrial sources in the US produced three times the CO₂ emissions of residential sources in 2010 (Lülfes and Hahn, 2013), while the buildings sector also consumes 20% of the total delivered energy worldwide (Conti et al., 2016). At the same time, the commercial sector features the fastest-growing energy demand, with its consumption projected to grow by an average of 1.6% per year until 2040 (Conti et al., 2016). More importantly, buildings account for 30–45% of the global energy demand, with commercial buildings, and primarily office and university buildings, classified amongst those presenting the highest energy consumption and savings potential (Gul and Patidar, 2015). Therefore, it is important to increase our efforts towards energy conservation in commercial buildings and workplace environments, towards addressing the worldwide recognised issue of energy wastage.

Albeit the documented effect of public buildings on energy consumption, only a limited body of research focuses on employees' energy consumption behaviour, which can certainly play a significant role in the buildings' energy footprint. Aiming to contribute to this research path, we are participating in an H2020 EU project (2016-2019) that develops a platform, which utilizes Internet of Things (IoT)-enabled smart meters, smart plugs, and low-cost sensors (e.g. NFC, iBeacons) to monitor energy use and, simultaneously, wastage per work device, area and employee. The ultimate goal of this research project is to use the accurate energy consumption data collected from the interconnected devices/things in order to transform the employees' energy usage behavior.

Gamification, “the use of game design elements in non-game contexts” (Deterding et al., 2011), has been identified as an instrument that, when appropriately utilised, could lead to employees' energy behaviour change. It can support companies to change behaviours, increase and sustain employee engagement and productivity (Webb, 2013), (Pickard, 2015). Furthermore, the active use of gamification for the improvement of business processes results in amplified workers' positive psychology, and strengthens positive emotions, engagement, relationships, the sense of meaning, as well as accomplishment (Uskov and Sekar, 2015). Thus, we were inspired to build, in the course of the project, a gamification application that receives input from the IoT-enabled platform and provides real-time recommendations to employees in three participating pilot sites, motivating and educating them to adopt a more green behavior.

To design an effective gamification app that the employees will adopt and use, we had to consider two important factors during the app's user requirements analysis: (i) employee personal profiles, needs and preferences, as well as (ii) workplace contextual characteristics. We first performed on-site visits to identify the contextual characteristics of the three different workplace environments that participate in the project. Then, we conducted a series of semi-structured interviews with representative employees (potential app users), to formulate a more holistic view of the three sites' special requirements. Our

primary focus was on collecting useful insight towards the design of a gamified app that matches the needs and preferences of its end-users, as well as serves the contextual limitations and opportunities of the pilot workplaces. In the next sections of the paper we begin by reviewing related work presented in the literature, discuss our observations through the site surveys, as well as our findings through interviews with employees, and conclude with our future research plans.

2 Related Work

2.1 Energy consumption in Workplaces

Energy in public buildings is mostly consumed through space heating and cooling systems – typically the largest energy consumption sources both in the EU and the US (Nguyen and Aiello, 2013) – lights, refrigerators, computers, and other equipment. Additionally, occupant behaviour is an important factor in the consumption of energy in buildings, as it can add, or save one-third to a building’s designed energy performance (Nguyen and Aiello, 2013). However, unlike private households, users at workplaces have by default no direct financial incentive to minimize energy use within their office workspace. Therefore, motivations, as well as incentive structures, for users in organizational settings are different, as no personal monetary gains are normally expected from a change in behaviours. Hence, more altruistic motives, like supporting the organization in energy and monetary savings, contributing to environmental protection, or complying with expectations from colleagues and superiors, can be leveraged to engage in energy saving behaviour at the workplace (Matthies et al., 2011).

Studies in energy consumption behaviours emerged with the oil crisis of the 1970s, from a wide range of disciplinary perspectives (Stephenson et al., 2010). Specifically, the findings of a meta-analysis of 156 published information-based energy conservation experiments encouraged us to explore the occupants’ energy behaviour in public buildings (Delmas, Fischlein and Asensio, 2013): (i) non-monetary, information-based strategies can lead to an average reduction in electricity consumption by 7.4%, (ii) monetary incentives, in contrast, lead to a relative increase in energy usage rather than inducing conservation, (iii) energy conservation through behavioural change should be considered alongside efforts to reduce energy consumption through technological improvements. Overall, a limited number of studies exist regarding energy conservation in a work environment, compared to household contexts. Very few studies have also investigated employee energy-related behaviours, none of which involving inter-organisational comparisons (Lo, Peters and Kok, 2012).

2.2 Gamification for Energy Efficiency purposes

The basic and most well-known gamification elements are points, badges and leaderboards – a useful starting point for gamification efforts – but a number of additional game elements exist (Werbach and Hunter, 2012). Single elements can fulfil different

functions, but in interaction with each other they can have varying and complex motivational effects (Sailer et al., 2013). The MDA (mechanics-dynamics-aesthetics) framework is widely used to categorise gamification elements (Zichermann and Cunningham, 2011). A commonly stated objective behind using gamification is to encourage behaviour change, in the form of increased participation, improved performance, or greater compliance (Seaborn and Fels, 2015). At the same time, gamification in a work environment can focus on business processes, or outcomes, involving participants, or players, both from outside and/or inside a firm, to improve employee satisfaction (Robson et al., 2015). When organizational goals are aligned with participants' goals, organizations can achieve their goals as a consequence of players achieving their goals, and employees can become fully engaged with new company initiatives (Dale, 2014). Furthermore, since gamification often involves storing and processing personal, potentially sensitive data, this could lead to "transparent employees" within company boundaries and, at the same time, inappropriate extrinsic incentives might crowd out intrinsic motivation (Blohm and Leimeister, 2013). Workplace gamification also needs to apply to long-term, apart from initiative-specific, objectives (Reiners and Wood, 2015). In a corporate setting, players have also tend to be more invested in intra-group, than in inter-group, competition (Nikkila et al., 2011). Gamification might also contradict with some personality types and cultural norms (Shahri et al., 2014), highlighting the importance of designing gamified applications to match their potential users' profile, by assessing their respective characteristics, as well as preferred game mechanics (Uskov and Sekar, 2015).

More specifically, various studies have suggested gamification as a means for motivating energy efficient behaviour. Grossberg et al. conducted a thorough review of gamified energy efficiency initiatives concluding that saving energy is highly rewarding in itself, and the greatest achievement a gamified app could aim for is to outline this fact to its users. Furthermore, they note that energy savings in the range of 3-6% have been reported on a number of studies featuring the application of gamification to reduce energy consumption, with an achievable possible savings of more than 10% (Grossberg et al., 2015). Inspired by the forementioned information, we decided to conduct a thorough observation of the three targeted workplaces, as well as a detailed exploration of the characteristics and preferences of our prospective gamified app participants. Our ultimate goal was to ensure that we will design and develop an effective gamified app that motivates employees towards a more energy-conscious behaviour.

3 Identifying Context and User Requirements

3.1 Physical observation of the workplaces

The gamified app will be deployed and pilot-tested in three different workplaces – participating in the forementioned EU-funded project – that are located in different European countries. The first workplace is a public office in Athens, Greece, which provides IT support to the facilities of its home organisation, both locally, as well as in

an on-site calling schedule. There are 55 employees and 14 separate rooms, whilst normally no visitors are hosted. Interestingly, almost a third of the employees are usually out of office, on on-site visits, therefore consuming less energy in general. The highest consumption of energy occurs for heating/cooling through the air-conditioners. Consumption varies, according to the position of the sun relative to the building's façade. In the summer, cooling is mostly needed in the afternoons, while, in the winter, heating is mostly needed in the mornings. Therefore, the energy usage patterns are affected by: time of day, external temperature and cloud coverage.

The second workplace is an electricity regulation agency in Barcelona, Spain, employing 49 employees in total. The building is always open and visitors in the floor covered by the agency are limited. The floor layout includes 1 open-space office area, 8 individual offices, 5 meeting rooms, 1 waiting room, 1 kitchen and restrooms. Employees cannot directly alter the climate conditions in the building, they can however open windows. External temperature and humidity conditions affect energy consumption, while around 40% of electricity consumption is due to air conditioning, as heating is provided by natural gas consumption. Smart meters are installed for monitoring the energy consumption per category of use (i.e., lighting, air conditioning), but no specific strategy for reducing energy-consumption has been set.

The third workplace is a public museum at the old City of Luxembourg. It comprises of 4 buildings, containing the exhibition rooms and 25 administrative offices. There are 100 employees in the museum, 40 of which administrative staff. Lights are always on in the exhibition area and visitor restrooms, during the museum's visiting hours. There are very few automated light switches and, although the daylight prevails in the museum rooms, many lights are kept on for security reasons. The largest part of energy consumption is due to lighting and the climate system in the exhibition rooms, which ensures the museum exhibits are secure and properly preserved. Heating in the administrative offices is controlled per office (1-2 people in the room) where there is no air-conditioning. Employees cannot alter the climate or lighting conditions in the largest part of the facilities, and museum visitors cannot act on the climate controls or any other energy consumption actuator. At a first glance, only the lift usage of visitors may alter their contribution to energy consumption in the museum.

Overall, through the physical observation process a number of common, as well as contradictory significant characteristics of the three pilot workplaces were highlighted. Table 1 summarizes our most important findings.

Table 1: Workplace characteristics to be considered for the design of the gamified application

	Public Office		Electricity Regulation Agency		Public Museum	
Workplace Location	Offices in single floor		Offices in single floor		Three buildings	
Nature of work	IT support, on and off-site		Office work		Museum, office back-end	
Number of Employees	55		49		100	
Visitors	almost none				~65.000 / Year	
Main energy offending devices & availability to interact with them through the gamified app	PCs-	Y	PCs-	Y	PCs-	Y
	Monitors	Y	Monitors	N	Monitors	N
	Fancoils	Y	Fancoils	Y	Fancoils	Y*
	Lighting	Y	Lighting	Y*	Lighting	Y
	Printers	Y	Printers	Y	Printers	Y
	Coffee Maker	Y	Coffee Maker	Y	Coffee Maker	Y
	Toaster		Toaster	Y	Microwave	
			Kettle			
			Microwave			
			*all shared units		* not in exhibition -only in offices	
Other possible energy conservation behaviours available	Windows	Y	Elevators	Y	Elevators	Y*
	Elevators	Y			* for employees & visitors	

The museum is different to both the other workplaces, in that it hosts a very large number of visitors per year, whereas close to no visitors are expected in the other two sites. At the same time, the climate and lighting conditions in most of the areas of the museum are very specific and, therefore, lights and climate control cannot be used in a gamified app for these areas. Furthermore, it consists of four whole buildings, as opposed to a single floor office space. The only area of the museum that resembles the other two workplaces is the employees' backend office area. A special, distinctive feature of the museum is that its visitors could conserve energy by opting to use the stairs instead of the elevator.

Regarding the office spaces in all three sites, a lot of similarities exist in the possible targeted behaviours. PCs, monitors and printers can be switched off more often, as well as lights, when not needed. Common area equipment – kettles, coffee makers, toasters and microwave ovens, depending on their availability on each site – can also be

introduced to a gamified app. Such shared equipment, as well as shared printers and lights, could be used in a game, by creating special rules to allocate points according to each individual’s energy conservation.

3.2 User Interviews: Method and Results

We performed in-depth, semi-structured interviews with a representative sample of employees per workplace, as a small amount of interviews can produce data capable of addressing a set research goal, selected with careful sampling and a thorough collection technique (Holloway, 1997). Furthermore, following the theoretical saturation rule of qualitative research, we sampled until no new information or insight was produced – 26 employees – also exceeding ten cases in consistence with the suggested valid range of case sampling (Eisenhardt, 1989).

Table 2: Interview Guide

Demographic info & role in organisation
Working conditions in terms of comfort and stress
Do you have your own office or do you share it with others?
Do you think that energy conservation is a real need or a business hype? Do you think energy consumption is mostly an environmental, or an economic problem?
Do you personally save energy at work? Give an example.
Do you turn the screen off when you leave the office for a while? Do you like to read on paper in general?
Do you consider yourself more energy efficient at home than at work?
Are you married? Do you have children? Are they energy-efficient?
Do you generally feel colder, or hotter than people around you?
Do you consider saving energy at work your personal responsibility?
Do you think that more energy can be saved at work? If yes, name as many cases as you can identify where energy is wasted at work.
Do you do anything about this waste? Do you think that your own actions matter or only collective actions may have an impact towards this end?
Do you think that a reward is deserved for being energy-efficient at work? Monetary or not?
If the reward is small, is it still motivating or discouraging for you?
Would you change your behaviour to save more energy at work?
Do you play games in general? What kind?
Do you own a smartphone? Do you use mobile apps?
Do you prefer competitive or collaborative games? If we were creating a game at work around energy efficiency, would individual or team competition be preferable to you? Would you prefer a collective goal setting over a competitive setting for this game?

Our intention was to gain a first understanding of the employees' habits, needs and preferences regarding energy consumption and gamified apps. We conducted a discussion starting from specific questions, but the order of questions was changing according to the order of the subjects discussed. We intended to elicit mostly spontaneous answers and we encouraged the participants to add their remarks in the end of the conversation, as they saw fit. Moreover, all information collected during the interviews was content analyzed and coded by three independent coders into categories pertaining to the present research. A number of categories were decided upon ahead of time (e.g. Game Element of Point, Badge etc.) while other categories were identified based on the employees' responses (e.g. setup of teams). In the case of disagreement on the classification of any particular statement, the disagreements were resolved upon joint discussion. Table 2 includes the questions used to stimulate the conservation. Respectively, Table 3 reports the feedback we received from the employees during the interviews.

Table 3: Summary of employee interview results

	Public Office	Electricity Regulation Agency	Public Museum
Interviewed Sample	5 / 55	9 / 49	12 / 100
Gender	4 Male – 1 Female	5 Male – 4 Female	3 Male – 9 Female
Role	Various: management(2), administrative (1), app. developer (1), technician(1)	Various: project mgt. (3), admin.(2), waste mgt.(1), energy efficiency (1), comms (1), finance (1)	Various: administrative (5) security-technical (3), managerial (3), scientific (1)
Shared (vs own) office	5/5	5/9	8/12
Energy conservation is a real need	3/5	5/9	12/12
I save energy at work	3/5	5/9	11/12
Feeling colder / hotter than other people	1/5 feel colder	4/9 feel colder	4/12 feel hotter, 4/12 feel colder
I consider saving energy at work my personal responsibility	2/5	7/9	9/12
Identified cases where energy is wasted at work	5/5: monitors- printers on standby, air-conditioners	9/9: lights, appliances left on afterhours”	10/12: heating, printers, elevators
Personal, or collective actions have impact?	2/5 personal, 3/5 collective	4/9 personal, 5/9 collective	7/12 personal, 5/12 collective
Reward is deserved for being energy-efficient	2/5	5/9	2/12
Even small rewards are motivating to me	1/5	2/9	7/12

I play games in general	3/5	5/8	5/12
Competitive vs collaborative game, Individual vs team play	3/5 collaborative-team competition	5/9 collaborative-team competition	8/12 collaborative-team competition
Game Goals: Collective vs Competitive	1/5 collective, 1/5 competitive	4/9 collective, 3/9 competitive	4/12 collective, 1/12 competitive
Special group-based electricity consumption behaviour	Technicians & IT print less. Administrative do most of the printing	Employees in open plan area share printers and lights.	Employees in exhibition area do not have access to many energy-saving actions.
Main problems identified by the interviewees	<ul style="list-style-type: none"> • Air Conditioner temperature not always set optimally. • Lights left on after operating hours or used when ambient light suffices. • Screens and printers left on stand-by mode when leaving. • Windows opened with the air conditioner on 	<ul style="list-style-type: none"> • Air Conditioner temperature very low in summer. • All lights ON even with few people, or ample natural light, in open space and common areas • Screens and printers left on when unused • Excessive printing • Coffee maker left on • Windows open with air conditioner on • Elevator overly used 	<ul style="list-style-type: none"> • No control over Air Conditioning, Lights, or opening Windows in the exhibition areas by employees, due to restrictions • Screens, Printers, PCs, Monitors often left on standby mode • Elevators could be used less

Based on the interview results, we can deduce a number of suggestions, regarding the differences and characteristics that a gamified application towards energy conservation should respect. First of all, the varying roles of the participants in the three sites seem to affect their daily duties, as well as their opportunities to act upon specific energy

conservation actions. For example, some need to print a lot of documents according to their duties, while others not at all. At the same time, the employees in the exhibition area of the museum, for example, do not have access to many energy saving actions in general. Secondly, working in a shared space presents further challenges towards designing a gamified app, as the individual actions of the participants also affect their colleagues, and therefore a level of cooperation towards common goals in the game may be preferable in these situations. Comfort levels are a parameter that also needs to be addressed, as the actions of the participants in a game, should not impede on the personal comfort of their colleagues, or lead to tension and disagreements. We should also take into account that some of the participants feel colder/hotter than their colleagues and this issue should not preferably be exacerbated by an app. Interestingly, when asked whether personal or collective actions have an impact on energy conservation at their respective workplaces, the participants were somewhat equally divided, indicating that the game should provide opportunities for both personal and collective actions to be acted upon.

The necessity of interviewing the prospective participants of a gamified app towards energy conservation was also demonstrated by the fact that different cases where energy is wasted are unanimously identified by the participants in the three different sites: At the “Public Office”, monitors and printers left on standby upon leaving, at the “Energy Agency” lights and appliances left on afterhours and, at the “Museum” heating, printers and elevators. As per the main problems that employees identified at their respective workplace, regarding energy consuming devices: Employees at the “Public Office” suggested that air conditioner temperature is not always set optimally, lights are left on after operating hours or used when ambient light suffices, screens and printers are left on stand-by mode when leaving and windows opened with the air conditioner on. At the “Energy Agency”, the air conditioner temperature may be very low during summer, all lights are left on even when a few people are present in commonly used areas – or when ample natural light suffices, screens and printers are left on when unused, excessive printing is reported, coffee makers are often left on afterhours, windows are opened with the air conditioner on, and the elevator is overly used by the employees that avoid using stairs instead. At the “Museum”, employees have no control over air conditioning, lights, or opening windows in the exhibition areas due to restrictions, screens, printers, PCs and monitors are often left on standby mode and elevators could probably be used less. All these actions can be targeted through a gamified app, according to the specific needs of each site, towards attaining the optimum behavioural effect on energy conservation.

As only some of the prospective participants, in two of the three sites, consider saving energy at work their own personal responsibility, the ones that do could be selected as leaders in a team-play scenario, so that they can provide positive role models for their fellow team mates. Furthermore, since both personal and collective actions are considered to have an impact on energy conservation by some of the participants, a gamified app towards that end should instigate both individual, as well as collective actions. This is further supported by the fact that on all sites the majority of the participants prefer a collaborative game with team competition, while the minority a competitive game

featuring solo play. The same stands for collective vs competitive goals. An additional interesting finding is also that varying percentages of employees in the three sites believe that a reward is deserved for being energy-efficient at the workplace as well as that the existence of even small rewards is motivating towards the same target. Therefore, a gamified app would be more efficient through the inclusion of tangible rewards, only for a percentage of employees. Depending upon the general trend on each site, as well as their availability by employers, the app could also selectively include these extrinsic means of motivation, to adhere to each specific situation. Finally, as only about half of the participants on all sites play games in general, a gamified app featuring only basic game elements and not an overly complex narrative or gameplay, could be more universally accepted, as well as effective, towards behavioural change.

Through the interviewing process, the participants' also provided some additional interesting insight, regarding what we should consider when designing a gamified app towards energy conservation at their workplace. The most prominent suggestions were:

- “Every single small action is important but in the end only collective actions will have a really deep impact.”
- “We have to conserve energy responsibly for our future and because we want to do it, not to collect rewards”
- “If we combine all the small consumptions, they may add up to a considerable amount of energy saving. The information of how much each device consumes in standby mode should be provided to the users”
- “In view of the great differences between the tasks of the Museum's staff, I do not see any possibility for competitive games. A collective goal can be more interesting.”
- “The game should have specific rules and a clear target”
- “Any awards should be divided between users, based on their contribution in the game.”
- “The gamified system should not make people feel guilty about their energy consumption”

4 Conclusion

A body of research exists, regarding energy conservation in public buildings, due to their large share in energy consumption worldwide. The use of ICT has also been featured in a number of studies aimed at energy conservation in public buildings. However, the effect of such solutions is limited by the building occupants' intentions to follow specific energy consumption behaviour. Gamification has been introduced in various contexts to instigate behavioural change, including energy conservation initiatives, where it has been utilised as a means to affect occupant behaviour. The results from the relative studies have been mixed, as well as difficult to compare, due to the vast differences in both the actors' and contexts' characteristics.

Aiming to amend this issue, we have followed a structured process, involving two steps: On-site visits to prospective pilot sites, as well unstructured interviews with a representative sample of the participants in future gamified apps aimed at energy conservation. We have provided the questionnaire used in the interviewing process, so that it can be used in future similar studies. Through our analysis, we have discovered a number of contextual differences between the pilot sites, as well as in the prospective participants' available, suggested and preferred actions towards energy conservation at their respective workplaces. At the same time we have also gathered insight, regarding the game related preferences of our participants in our field of application. By combining all this information, we can design a gamified application to better match both our future participants' context, as well as preferences, leading to an overall better-suited solution to a better-defined problem. Therefore, we expect the effectiveness of our resulting application to be enhanced, compared to cases where neither the context, nor the preferences of the prospective participants of a gamified app have been analysed in advance.

Based on our findings, we have identified the main elements that affect the design of a gamified application towards energy conservation in the three workplaces surveyed. Employee roles and daily routines, existing limitations towards specific behaviours within the workplace (e.g. standard procedures - SOPs), the layout in the workplace (shared workspaces vs individual offices), existing employees' comfort levels, and different opportunities to conserve energy in each workplace, affect the accessibility, as well as impact of specific energy saving actions that can be included in a gamified app. As per the app design itself, in our pilot sites, both personal and collective actions, individual and team play should be considered, while – since only a few of the employees play games – a basic game play could be more effective in energy behaviour change.

Apart from its merits, our study also bears some limitations. First of all, we have investigated our prospective participants, by interviewing a sample (12.74 %) of employees. Therefore, our findings would be better grounded, if we were given the opportunity to interview all of the employees at the sites we visited. In addition, we conducted the on-site visits only once in each site, whereas a longitudinal study could provide more accurate results, as well as additional insight not currently recorded. Finally and more importantly, we expect that the validity, as well as usefulness of the methodology we propose, would be significantly enhanced, by a practical application of our findings in an actual gamified energy conservation experiment that would be conducted in our surveyed pilot sites. We aim to proceed towards this direction through our research in the future.

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Consumer Emotions and E-commerce: A Literature Review

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Abstract The purpose of this paper is to take a look at the current state of the research related to consumer emotions in the context of electronic commerce (e-commerce). As the popularity of online shopping is constantly growing, the author performed an integrative literature review of 66 journal articles on e-emotions (consumer emotions visible in an online environment) and classified the articles into four groups. According to the analysis of the groups, consumer emotions are present at various points of the e-commerce relationship from pre-purchase intentions to post-consumption behavior. Based on this literature review, directions for future research in e-emotions are also introduced.

Keywords: • Emotions • Electronic Commerce • Online Shopping • Literature Review •

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1 Introduction

Recent statistics show that consumers are more committed to electronic commerce (e-commerce) than ever. The prediction is that 46.4 % of all Internet users worldwide will purchase products online in 2017 (Statista, 2017). The growing interest in e-commerce also means that varying consumer emotions are likely involved before, during, and after online shopping encounters. Emotions are important during these encounters as alongside trust they attempt to moderate the relationship quality between the consumer and the service provider of online services (Sanchez-Franco & Rondan-Cataluna, 2009). New technologies can enhance the shopping experience, but long-lasting evidence shows that online users are individuals with unique characteristics and emotions (Burke, 2002). Almost two decades ago, scholars indicated that affective and emotional dimensions truly matter as part of the consumer decision-making process on- and offline (Shiv & Fedorikhin, 1999).

Emotions differ from similar concepts, such as sensations and feelings, and emotions “are also initiated by some particular objects or events, real or imagined, and they tend to motivate particular kinds of behavior” (Robinson, 2008, p. 155). In this paper, the focus is on e-emotions, which are seen as emotional states of a consumer that are somehow apparent and visible in an online environment. Consequently, consumer e-emotions matter at multiple levels of the service relationship, including pre- and post-consumption stages. Thanks to the development of technology and the expansion of social networking environments, the online environment has changed drastically in recent years making especially post-consumption behaviors more public. For example, electronic word-of-mouth (eWOM) has a significant role in consumer emotion build-up and affects other consumers’ pre-consumption stages (Chu & Kim, 2011). The current development has led to the situation in which communication is also more dynamic and active than ever before (Brodie et al., 2011; Freeman et al., 2010; Luoma-aho & Paloviita, 2010; Luoma-aho & Vos, 2010).

Active interaction between consumers, stakeholders, and organizations is part of the so-called engagement process (Brodie et al., 2013; Brodie et al., 2011; van Doorn et al., 2010). Additionally, online users engage with various objects, such as brands, products, and virtual brand communities (Brodie et al., 2013). These engagement processes are often accompanied by different emotions and behaviors that thus play a central role in e-commerce, as well as in stakeholder relations in general (Luoma-aho & Paloviita, 2010).

Although literature reviews of online shopping motives and intentions (e.g., Monsuwé, Dellaert, & de Ruyter, 2004), as well as of the adoption of computer-mediated services (e.g., Beldad, de Jong, & Steehouder, 2010), exist, there is an emerging need to generalize the current state of the research related to consumer emotions in the context of online shopping. As technology and consumer behavior are changing, management must understand this development and identify possible consumers’ and customers’ pain points (Lemon & Verhoef, 2016). Currently, the research related to e-emotions and e-commerce

is fragmented across various fields and disciplines, and a comprehensive understanding of the topic is difficult.

This study responds to this need and is implemented as an integrative literature review. This paper is a preliminary attempt to gather the research literature related to consumer e-emotions in the context of online shopping and the current state of the research across various disciplines—information technology, psychology, communication, and marketing—was synthesized and analyzed. By gathering previous articles published in peer-reviewed journals, the goal in this paper is to classify the literature related to the topic, and through review and synthesis introduce the key findings.

This paper is organized as follows: First, the process of the integrative literature review is introduced. Second, the relevant literature gathered during the process is assembled and the results introduced. Third, the results are combined, and the synthesis and analysis of the literature review are presented. The key findings in the literature are addressed. Finally, the validity and reliability of the study are discussed, and suggestions for future research are provided.

2 Methodology: Integrative Literature Review

This study utilized the integrative literature review method (see Torraco, 2005). Integrative literature reviews balance between less structured descriptive literature reviews and more structured systematic literature reviews (Birmingham, 2000). This method “is a form of research that reviews, critiques, and synthesizes representative literature on a topic in an integrated way such that new frameworks and perspectives on the topic are generated” (Torraco, 2005, p. 356). Although this study was integrative, it followed Fink’s (2010) model of systematic literature review consistently to add more validity and reliability.

The first step in Fink (2010) model is to select the research questions. This step is critical because the research questions aim the researcher in the decision-making process and address what kind of articles should be included (Jesson, Matheson, & Lacey, 2011). This study answers the following research questions: 1) According to previous literature, what kind of research and studies have been put into practice related to consumer emotions in online shopping? 2) According to the literature analyzed in this study, what are the recent key findings related to consumer emotions in e-commerce?

The second step was selecting the databases from which to look for literature (Fink, 2010). In this study, the goal was to cover interdisciplinary literature related to emotions in e-commerce across the following disciplines: information technology, psychology, communication, and marketing. The following bibliographic databases were utilized: ABI/INFORM Complete (ProQuest), Business Source Elite (EBSCO), Computer and Information Systems Abstracts (ProQuest), Emerald Insights (Journals) (Emerald), ProQuest Psychology Journals (ProQuest), and PsycARTICLES (the American Psychological Association).

After the databases were selected, search terms were chosen (Fink, 2010). Search terms should frame the topic enough so the appropriate literature can be found. However, the framing should not be too tight (Fink, 2010). The search terms were defined based on the research questions. The literature searches were conducted in February 2017. Advanced or multi-field searches were used in the databases, and the following search terms were applied in order to find relevant literature: *emotion* AND online AND shop* OR e-commerce*. The search terms were restricted to be present in the key words or subject terms. The author also applied the limitation of the search to peer-reviewed content if this option was applicable in the databases in the advanced search options. The ProQuest and EBSCO databases offered this option and the Emerald and American Psychological Association databases did not offer this option in the advanced search. The input of the search terms in the databases gave the following results: ABI/INFORM Complete (ProQuest), 73 results; Business Source Elite (EBSCO), 13 results; Computer and Information Systems Abstracts (ProQuest), 73 results; Emerald Insights (Journals) (Emerald), 251 results; ProQuest Psychology Journals (ProQuest), 73 results; and PscyARTICLES (American Psychological Association), 1 result.

As can be seen from the search results, all ProQuest databases offered the same amount of literature. The results were also similar in content so the three ProQuest databases were treated as one entity during the review process. According to Fink (2010), the preliminary literature searches usually give many results. Therefore, it is important to screen for articles with certain criteria to find the relevant articles (Fink, 2010). After the searches were conducted in the databases, the practical screen and methodological quality screen (Fink, 2010) was applied by executing following inclusion criteria: peer-reviewed journal articles (also including content from the Emerald and APA databases), published since 2006, and studies related to emotions in the context of e-commerce or online shopping. The following research designs and content were excluded from the review: literature reviews and conference proceedings.

The review (Fink, 2010) was conducted in two stages. In the first stage, the headings and abstracts of the studies were read. Through this, the most likely relevant literature to include in the final review was found as Jesson et al. (2011) suggested. In the second stage, the literature was scanned more thoroughly. At this stage, it was also important to analyze research designs, findings, and conclusions of the studies before deciding what literature should be included for the final review (Jesson et al., 2011). The articles in the review are shown in Table 1 in the next section.

After the literature for the final review was apparent, it was time to synthesize the results (Fink, 2010). These conclusions are introduced in a more specific manner in the following sections, where the content of the review is interpreted and analyzed. The key findings of the studies are also reviewed more thoroughly in later parts of this paper.

3 Results of the Literature Review

After a careful scan of the available literature, 66 peer-reviewed articles were included in the final review. Studies that had interfaces with consumer emotions in the context of e-commerce were included. This was evaluated through keywords, and how, at the same time, the studies focused on the topic in a recognizable way in the research design and/or findings. Articles that did not match the criteria or did not cover the topic clearly enough were excluded from the review.

The literature consisted of studies covering (either directly or indirectly) information technology, psychology, communication, and/or marketing. The articles were classified into four groups: studies related to website design, characteristics, or atmosphere and how they generally affect consumer emotions and behavior; studies related to pre-consumption emotions and predictors of consumers' online shopping intentions and activities, such as the effects of online user reviews; studies related to consumer emotions during actual online shopping encounters, for example, decision making in purchase situations; and studies related to consumer post-consumption emotions and behavior, such as repurchase intention and commitment to eWOM.

In general, recent studies focused on consumer e-emotions during all stages of the (service) relationship. This result supports the assumption that e-emotions are not just restricted to the purchase or buying situation. In fact, consumer emotions and behaviors are under scrutiny in multiple situations. People eagerly read reviews and participate in public discussion before making a purchase decision, and even after the consumption stage, there is a possibility that the experience turns either good or bad. Consumers possibly continue the service relationship, disengage with the service provider (Bowden, Gabbott, & Naumann, 2015), or even engage in eWOM (Chu & Kim, 2011) after e-commerce encounters.

4 Analysis of the Key Findings in the Reviewed Articles

The literature was analyzed in the four groups. The idea was to explore and compare the key findings within the groups and draw conclusions based on these findings. The literature is presented in Table 1. In addition, the most relevant and synthesized key findings of the studies of each group, and the authors, are introduced.

Table 1: Reviewed literature

Group of the reviewed articles	Relevant key findings	Author and year
<p>1) Studies related to website design, characteristics, or atmosphere and how they generally affect consumer emotions and behavior</p>	<p>Consumers' emotions influence their perception of atmospheric cues (such as music and color) on websites affecting site attitude, site involvement, and purchase intention.</p> <p>Human images and human brands on websites stimulate higher levels of enjoyment and positive emotions.</p> <p>Product presentation has a significant effect on consumers' emotional responses on websites.</p>	<ul style="list-style-type: none"> ▪ Wang et al., 2014 ▪ Mazaheri et al., 2014 ▪ Mazaheri, Richard, & Laroche, 2012 ▪ Fei-Fei et al., 2009 ▪ Bui & Kemp, 2013 ▪ Zhang et al., 2014a ▪ Davis, Wang, & Lindridge, 2008 ▪ Young & Im, 2012 ▪ Jung-Hwan, Kim, & Lennon, 2009 ▪ Porat & Tractinsky, 2012 ▪ Wu, Cheng, & Yen, 2008 ▪ Ding & Lin, 2012 ▪ Wu et al., 2014 ▪ Jeong et al., 2009 ▪ López & Ruiz, 2011
<p>2) Studies related to pre-consumption emotions and predictors of consumers' online shopping decisions and activities, such as the effects of online user reviews</p>	<p>Cultural differences exist between online retailer reputation and retail quality, and how they affect consumer emotional and cognitive reactions and intentions before shopping.</p> <p>If online user reviews are inconsistent, they affect consumers' purchase intention.</p> <p>In addition, positive emotions mediate the relationship between personalization and purchase intentions.</p> <p>Consumer attitude, perceived difficulty of</p>	<ul style="list-style-type: none"> ▪ Zhang et al., 2014b ▪ Pappas et al., 2014 ▪ Lee et al., 2016 ▪ Kim, Yang, & Bu, 2013 ▪ Scholl-Grissemann & Schnurr, 2016 ▪ Yin, Bond, & Zhang, 2014 ▪ Luo et al., 2011 ▪ Kang, 2014 ▪ Peng et al., 2016 ▪ Sharma & Lijuan, 2014 ▪ Quevedo-Silva et al., 2016 ▪ Choi & Nazareth, 2014 ▪ Yen, 2014 ▪ Chen, Wu, & Chang, 2013

	<p>website use, and shoppers' previous experience are also antecedents of purchase intentions.</p> <p>To create an emotional attachment to browsing and increase purchase intention, online retailers should focus on consumer pleasure and community relationships.</p>	<ul style="list-style-type: none"> ▪ Hernandez, Jimenez, & Martín, 2009 ▪ Soto-Acosta et al., 2014 ▪ Jin & Lee, 2014
<p>3) Studies related to consumer emotions during actual online shopping encounters: for example, decision making in purchase situations</p>	<p>High-quality web design interface and consumers' product involvement elicit positive emotions during shopping. In addition, consumers' product involvement is important for eliciting positive emotions.</p> <p>Cognitive and emotional responses play a key role in communication through online stores.</p> <p>A linear relationship exists between the level of interactivity provided by an online store and pleasure, which increases the likelihood of purchasing.</p> <p>Enhanced perceptions of human connection and the formation of emotional bonds provide a competitive advantage for online retailers.</p> <p>Mixed emotions are likely to lead consumers to leave the stores.</p>	<ul style="list-style-type: none"> ▪ Chechen et al., 2016 ▪ Richard & Chebat, 2016 ▪ Guo et al., 2015 ▪ Moody et al., 2014 ▪ Bonera, 2011 ▪ Peiris, Kulkarni, & Mawatha, 2015 ▪ Huang & Kuo, 2012 ▪ Yao & Liao, 2011 ▪ Li, Sarathy, & Zhang, 2008 ▪ Ozen & Engizek, 2014 ▪ Kim & Lennon, 2010 ▪ Ballantine & Fortin, 2009 ▪ Hsin & Hsin-Wei, 2011 ▪ Moran & Kwak, 2015 ▪ Penz & Hogg, 2011 ▪ Liao et al., 2016 ▪ Chae & Kun, 2013 ▪ Wang et al., 2007 ▪ Wen et al., 2014

	Hedonic value drives online impulse buying tendencies.	
<p>4) Studies related to consumer post-consumption emotions and behavior, such as repurchase intention and commitment to word-of-mouth</p>	<p>Positive emotions increase post-consumption satisfaction, which positively affects post-purchase intentions. In turn, negative emotions are an important mediator between dissatisfaction and repurchase intention.</p> <p>Satisfaction and perceived usefulness of a website contribute to individual online shopping continuance intention in the future.</p> <p>Transaction cost advantage, preview, and trust significantly and positively affect satisfaction, which, in turn, influences repurchase intention.</p> <p>Emotions felt after visiting a web store positively influence the perceptions of the website atmospherics that, in turn, influence a set of behavioral variables ending with intention to (re-)purchase.</p> <p>Online shoppers' excitement and positive perceived quality lead to positive word-of-mouth (WOM) and increase the intent to return.</p>	<ul style="list-style-type: none"> ▪ Kuo & Wu, 2012 ▪ Yunfan, Yaobin, & Bin, 2012 ▪ Lu, Lu, & Wang, 2012 ▪ Urueña & Hidalgo, 2016 ▪ Mohamed et al., 2014 ▪ Chou & Hsu, 2016 ▪ Richard & Habibi, 2016 ▪ Jayawardhena & Len, 2009 ▪ Gounaris, Dimitriadis, & Stathakopoulos, 2010 ▪ Kim et al., 2014 ▪ Lim, 2015 ▪ Lin, 2012 ▪ Sharma & Lijuan, 2015 ▪ Vos et al., 2014 ▪ Matute et al., 2016

As can be seen in table 1, the studies indicated that the research in e-emotions is diverse and versatile. Moreover, the perspectives in these articles were broad and interdisciplinary. The studies explored consumer online emotions, behaviors, and their relations to e-commerce at multiple levels from pre-purchase to post-consumption stages. Next, this paper takes a closer look on the key findings presented in Table 1.

4.1 Website Design Effects on Consumer Emotions

According to the key findings in the articles in Group 1, the website characteristics, design, and atmosphere usually have a major influence on consumers' emotions, as well as on behavior. First, cultural differences exist in emotional responses and perceptions in online shopping environments (Davis et al., 2008; Mazaheri et al., 2014). Emotions are crucial in the perception stage of the atmospheric and characteristic cues of websites and affect consumers' attitude toward the site, level of involvement, and purchase intention (Mazaheri et al., 2012; Porat & Tractinsky, 2012; Wang et al., 2014; Wu et al., 2014; Zhang et al., 2014a).

Studies show a website that uses images of humans, instead of generic cues, stimulates higher levels of positive emotions and enjoyment (Wang et al., 2014). Music and colors used on these sites also have an effect on the emotional responses of potential customers and users (Bui & Kemp, 2013; Ding & Lin, 2012; Fei-Fei et al., 2009; Wu et al., 2008). Product presentation and store layout are also important as they are emotionally valid characteristics and part of a pleasant shopping experience (Jung-Hwan et al., 2009; Young & Im, 2012). Interestingly, emotional trust has a role in influencing consumers' purchase intention (Zhang et al., 2014), and cognitive and emotional responses play a key role in communication through the websites (López & Ruiz, 2011). In addition, website patronage intention is affected by pleasure, arousal, entertainment, and esthetic experiences consumers receive (Jeong et al., 2009).

4.2 Pre-consumption Emotions

According to the key findings in the articles in Group 2, pre-consumption emotions and expectations of certain e-commerce services are usually influenced by the information available online. The information is often available through user reviews, and through public discussion on social media and discussion forums. However, information overload has a negative effect on consumer emotions and thus affects purchase intention (Soto-Acosta et al., 2014).

Short- or long-term price drops significantly affect how consumers respond in public product reviews (Lee et al., 2016). If online user reviews are inconsistent, cognitive trust and emotional trust are affected (Zhang et al., 2014b). As Zhang et al. (2014a) claimed, emotional trust most likely affects purchase intention (Sharma & Lijuan, 2014). Anxious or enthusiastic online reviews are considered more helpful than angry reviews (Yin et al., 2014). The amount of review manipulation also matters. Consumers usually have a

negative view if online reviews are deceptive or manipulated, but the degree of negativity varies depending on the manipulation tactics (Jin & Lee, 2014; Peng et al., 2016).

If there is proof that the potential e-commerce retailer has had severe trust violations in the past, reconciliation efforts are meaningful when consumers ruminate on their potential options (Choi & Nazareth, 2014). Strategies for repairing trust are effective in building a positive mood, which, in turn, is an important mediator in rebuilding consumer trust (Chen et al., 2013). Additionally, positive emotions mediate the relationship between personalization and purchase intentions (Pappas et al., 2014), and the consumer's experience affects these intentions as well (Hernandez et al., 2009). However, the reconciliation tactics should be moderate, as consumers are affected by the tactics used (Choi & Nazareth, 2014; Peng et al., 2016). Moreover, the severity of the trust violation also affects consumer perceptions (Choi & Nazareth, 2014). How these efforts are documented and presented publicly is also important. Consumers seek this information, and they evaluate the firm's reputation (Kim et al., 2013) so that they can be certain and trust the online shop they are going to use.

To create an emotional attachment to browsing and increase purchase intention, online retailers should focus on consumer pleasure and community relationships (Luo et al., 2011). Hedonic choice options are also important as they are more strongly related to positive emotions and pleasurable experiences than utilitarian online shopping options (Scholl-Grissemann & Schnurr, 2016), even though hedonic performance expectancies are not always positively related to usage intentions (Kang, 2014). Cognitive and emotional responses, as well as the interaction, play a key role in communication through websites (Yen, 2014). This also indicates how tempting the websites look to potential customers and how easy the sites are to use (Quevedo-Silva et al., 2016).

4.3 Consumer Emotions During Actual Online Shopping Encounters

According to the key findings in the articles in Group 3, emotional and rational routes, as well as e-service quality, influence consumers during the online shopping process (Hsin & Hsin-Wei, 2011; Wen et al., 2014). Not only high-quality website design but also consumers' product involvement elicits positive emotions during these encounters (Chechen et al., 2016). Emotions encompass pleasure, arousal, and dominance, and they precede cognition (Richard & Chebat, 2016). Moreover, a linear relationship exists between the level of interactivity provided by an online store and pleasure (Ballantine & Fortin, 2009). Pleasure increases the likelihood of purchasing during the e-commerce encounters (Kim & Lennon, 2010), and at the same time, consumers' previous emotional experiences can affect their behavior (Guo et al., 2015). In these circumstances, using human brands, and utilizing enhanced perceptions of human connections and the formation of emotional bonds, could provide a competitive advantage for online retailers (Ballantine & Fortin, 2009; Chae & Kun, 2013; Wang et al., 2007).

Incidental moods tend to increase process impulsivity in online shopping decisions (Huang & Kuo, 2012). Differences in users' emotional experiences on e-commerce

websites are primarily embodied in subjective emotional ratings and eye movements (Guo et al., 2015). Mixed emotions are likely to lead to consumers leaving the stores (Penz & Hogg, 2011).

A common issue for e-commerce retailers is that customers are not ready to proceed through checkout procedures. For example, emotions can have a significant impact on the decision to give personal information that is necessary (such as credit card numbers) to complete a purchase on a website (Li et al., 2008). The consumer's online shopping cart might already be filled with various products, but especially first-time customers might be suspicious (Li et al., 2008). Trust and distrust coexist in online e-commerce relationships and can result in ambivalence when they have high attitudinal values represented in emotions, beliefs, or behaviors (Moody et al., 2014). Use of the principles of web usability guidelines and trust indicators will improve consumers' emotion about adopting e-commerce (Peiris et al., 2015) and increase the likelihood that consumers complete the checkout process. The purchase encounter must be as reliable as possible because perceived risk in e-commerce has a significant negative effect on consumers' satisfaction (Yao & Liao, 2011).

Hedonic values and aspects are important for online store users. Hedonic values increase online impulse buying tendencies (Ozen & Engizek, 2014). Interestingly, consumers who are under stress have a higher impulse buying tendency as well (Moran & Kwak, 2015). High or low hedonistic emotional commitment seems to be important to the perception of the usefulness of an online store (Bonera, 2011). For utilitarian products, therefore, it is important to offer a high-quality web design interface and move toward enhancing consumers' product involvement, as they are also crucial for eliciting positive consumer emotions (Chechen et al., 2016; Liao et al., 2016).

4.4 Post-purchase Emotions

According to the key findings in the Group 4 articles, the post-consumption or post-purchase stages are crucial for e-commerce retailers. Customers and consumers tend to expect that after the purchase has been successfully executed, the service relationship will continue, ordered products are received on time, and the product qualities are as expected (Sharma & Lijuan, 2015; Vos et al., 2014). Positive emotions increase post-satisfaction, which positively affects post-purchase intentions as well (Kuo & Wu, 2012).

Emotional stability moderates the relationship between the perceived usefulness of a website and satisfaction in online shopping (Mohamed et al., 2014). Emotions felt after visiting a website positively influence consumers' perceptions of the website atmospherics that, in turn, influence a set of behavioral variables ending with intention to purchase again (Richard & Habibi, 2016). For example, transaction cost advantage, preview, and trust significantly and positively affect satisfaction, which, in turn, influences repurchase intention (Kim et al., 2014). Moreover, satisfaction and perceived usefulness of the website contribute to individual online shopping continuance intention (Lim, 2015; Mohamed et al., 2014). Interestingly, shopping habit increases the influence

of emotional evaluation on continuance, while at the same time habit weakens the impact of rational evaluation on continuance intention (Chou & Hsu, 2016).

Online shoppers' excitement leads to positive word-of-mouth (WOM) and increases the intent to return (Jayawardhena & Len, 2009). Moreover, online service quality has a positive effect on satisfaction, while also influencing, directly and indirectly through satisfaction, consumers' behavioral intentions: site revisit, word-of-mouth communication, and repeat purchases (Gounaris et al., 2010). Although electronic WOM has a positive direct effect on consumers' intention to repurchase, quantity has a negative influence (Matute et al., 2016). Thus, it is necessary to monitor the tone of consumers' public discussion during the post-purchase stage.

If service failures have occurred, the switching intentions of consumers who are affected by negative emotions become stronger when the failures are controllable factors that could be managed and prevented (Lin, 2012). However, if consumers are treated in an appropriate way after the failure, the studies show that distributive justice (such as monetary compensation) increases positive emotions and decreases negative ones (Kuo & Wu, 2012). Furthermore, negative emotions also affect repurchase intention (Lu et al., 2012; Yunfan et al., 2012). In addition, procedural justice, such as received fairness from the company, enhances satisfaction, especially after the consumer has complained and the company seeks service recovery (Urueña & Hidalgo, 2016).

5 Conclusions

This study was a preliminary attempt to group and analyze peer-reviewed journal articles related to consumer emotions in the context of e-commerce. The author aimed at contributing to academia and practice, and introduced four groups of the current state of consumer e-emotions research in the context of online shopping. Groups 1 and 2 included studies on the effects of website design on emotions and studies on pre-purchase emotions. Groups 3 and 4 included studies on actual online shopping encounters and their effects on emotions, as well as studies on post-purchase emotions and behavior. In addition, the author synthesized and analyzed the key findings of the reviewed studies. By recognizing the emerging need and timely challenge of understanding online users and their emotions better, the goal of this paper was to increase the knowledge of the topic, and the paper brought up new perspectives by combining the previous research findings.

According to the analysis, consumer emotions are present at various stages of the e-commerce relationship. For example, website design and characteristics affect consumer emotions, which, in turn, mediate site involvement. In the pre-consumption stage, emotions initiate the purchase intention, and during actual online shopping encounters, positive emotions and trust increase the likelihood of purchases. Post-consumption emotions are also interesting as they mediate the behavioral responses of the consumer, such as word-of-mouth and intention to return to the web store.

As a preliminary attempt, this study has several limitations. Most noticeably, the search terms and databases used in the process affected the availability of the reviewable literature. Using different search criteria and databases could, naturally, provide alternative results and guide the indications to alternative directions than presented in this paper. However, using similar search terms should be possible in almost any academic database and give similar results.

From a research method perspective, an integrative literature review has advantages and disadvantages. The most recognizable difference between this study and systematic reviews was the analysis. Systematic reviews aim at offering a systematic descriptive review analysis or even perform a meta-analysis (Fink, 2010), while the goal of this paper was simply to combine the current state of the research in a condensed form and reconstitute the current knowledge by utilizing conceptual grouping. The author also wanted to synthesize the results and analyze the key findings with flexibility in mind to add something new to the topic as Baumeister and Leary (1997) suggested. Reviews that were conducted too systematically and mechanically might lack essential details.

Additionally, integrative literature reviews do not have to differ much from systematic reviews, if they follow a clear pattern and utilize a structured methodological grasp (Salminen, 2011). The author accomplished this by implementing Fink's (2010) systematic method diversely during the review process. These actions also added credibility and validity to the study (Dixon-Woods, Booth, & Sutton, 2007). This mixed approach was also flexible, as the literature related to the topic was fragmented across various fields and disciplines. Finally, yet importantly, the author's goal was to follow Torraco (2005) who implied that an integrative literature review has "an important role in stimulating future research on the topic" (p. 364). As a tendency of positive and negative consumer e-emotions in e-commerce is still somewhat unclear, the author suggests that future studies should answer the following research questions: What usually causes positive emotions in the context of e-commerce when customers are motivated and intend to buy from an online store? What emotions are present when consumers have negative e-commerce experiences? What prevents consumers from buying from an online store?

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Age Differences in Technology Readiness and Its Effects on Information System Acceptance and Use: The Case of Online Electricity Services in Finland

MARKUS MAKKONEN, LAURI FRANK & KERTTULI KOIVISTO

Abstract Although technology readiness (TR) has been found to influence the acceptance and use of information systems (IS), little is known about how TR varies in terms of different demographic variables and how these demographic variables moderate the effects of TR on IS acceptance and use. In this study, we aim to address this gap in prior research by examining the potential age differences in the four technology readiness index (TRI) constructs as well as their effects on IS use intention and its two main antecedents hypothesised in the technology acceptance model (TAM): perceived usefulness and perceived ease of use. The examination is conducted in the context of online electricity services and based on 1,176 online survey responses collected from Finnish consumers and analysed through structural equation modelling (SEM). The findings of the study suggest age differences in the optimism, innovation, and discomfort constructs of TRI, but not in the effects of any of the TRI constructs on the TAM constructs. These findings and their implications are discussed in more detail especially from the perspective of the so-called “young elderly” segment consisting of individuals aged 60–75 years.

Keywords: • Information System Acceptance and Use • Age Differences • Technology Readiness Index • Technology Acceptance Model • Online Electricity Services •

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1 Introduction

In several prior studies (e.g., Lin, Shih & Sher, 2007; Walczuch, Lemmink & Streukens, 2007; Lin & Chang, 2011; Godoe & Johansen, 2012), technology readiness (TR) has been found to significantly influence the acceptance and use of information systems (IS). Typically, individuals who rank higher in terms of TR have been found to be more apt adopters of IS in contrast to those whose ranking is lower. However, in spite of this central role, TR has gained relatively little attention in IS research. For example, little is known about how TR varies in terms of different demographic variables and how these demographic variables moderate the effects of TR on IS acceptance and use as well as its main antecedents. In this study, we aim to address this gap in prior research by examining the aforementioned issues in the case of one highly important demographic variable: age. Age is a demographic variable that has been of high interest in several prior studies on IS acceptance and use. For example, in the well-known and widely used unified theory of acceptance and use of technology (UTAUT) by Venkatesh et al. (2003) as well as its extension UTAUT2 by Venkatesh, Thong, and Xu (2012), age is hypothesised to act as an important moderator for the effects of various antecedent constructs on IS acceptance and use. However, no studies that we are aware of have examined age as a moderator for the effects of TR on IS acceptance and use as well as its main antecedents.

We conduct our examination in the case context of online electricity services offered by electric suppliers, which allow their customers, for example, to manage their electricity contracts and track their electricity consumption over the Internet. Such services have become increasingly common in the recent years and offer an ideal case context for the current study because they are often used by individuals with a widely varying age range. The only main exceptions are typically the very youngest and the very oldest individuals, who either still live at their childhood home or live in some sort of communal accommodation, such as a student apartment or a retirement home. As a theoretical framework for conceptualising and operationalising IS acceptance and use, its main antecedents, as well as TR, we utilise the technology acceptance model (TAM) by Davis (1989) and the technology readiness index (TRI) by Parasuraman (2000), which have also been integrated together in several prior studies (e.g., Lin, Shih & Sher, 2007; Walczuch, Lemmink & Streukens, 2007; Lin & Chang, 2011; Godoe & Johansen, 2012).

This paper is structured as follows. After this brief introductory section, the theoretical foundation of the paper is discussed in Section 2. After this, the methodology and results of the study are reported in Sections 3 and 4. The results are discussed in more detail in Section 5, concentrating especially on the implications for the so-called “young elderly” segment consisting of individuals aged 60–75 years. Finally, Section 6 considers the limitations of the study and some potential paths of future research.

2 Theoretical Foundation

TAM by Davis (1989) is an adaptation of the theory of reasoned action (TRA) by Fishbein and Azjen (1975, 1980) to the IS context, which posits that the acceptance and use of a particular system can be best predicted by the use intention towards it. Use intention, in turn, is hypothesised to be predicted by two main antecedents associated with the perceived system characteristics: perceived usefulness (PU), which has traditionally been defined as “the degree to which a person believes that using a particular system would enhance his or her job performance”, and perceived ease of use (PEOU), which has traditionally been defined as “the degree to which a person believes that using a particular system would be free of effort” (Davis, Bagozzi & Warshaw, 1989). The more useful and easier to use a particular system is perceived to be, the higher should be the intention to use it. In addition, perceived ease of use is hypothesised to act as a predictor of perceived usefulness, so that systems that are perceived as easier to use should also be perceived as more useful. These hypotheses are illustrated in Figure 1.

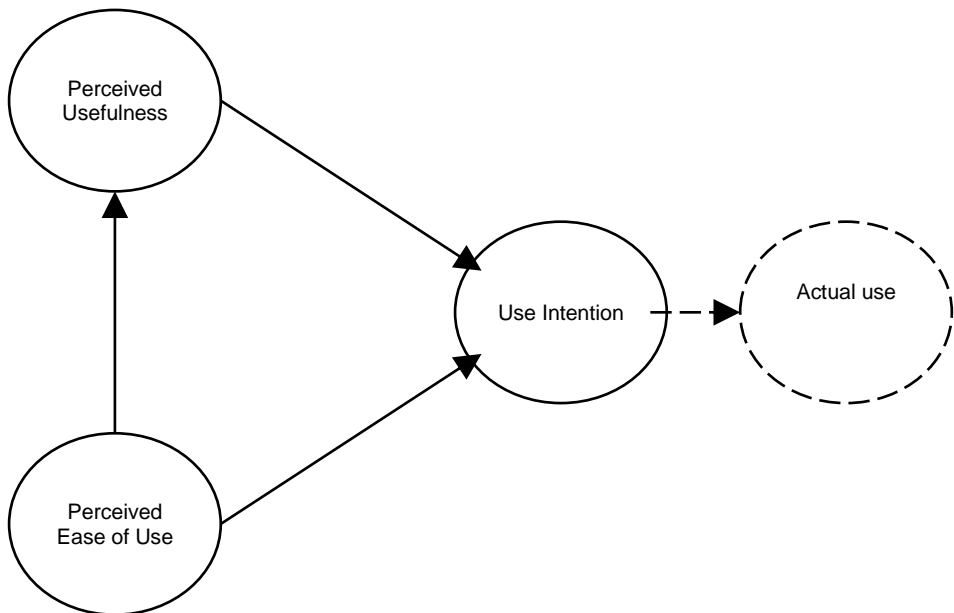


Figure 1: Technology acceptance model (TAM)

Although TAM was originally developed to explain and predict IS acceptance and use only in the organisational context, it has since been applied also outside it. To promote its applicability to other contexts, numerous extensions to the original TAM have been suggested, such as TAM2 (Venkatesh & Davis, 2000) and TAM3 (Venkatesh & Bala, 2008) as well as the aforementioned UTAUT (Venkatesh et al., 2003) and UTAUT2 (Venkatesh, Thong & Xu, 2012). In this study, we utilise only the original TAM as our

theoretical framework for conceptualising and operationalising IS acceptance and use as well as its main antecedents because we consider it highly applicable to our current case context of online electricity services, which can be characterised as utilitarian self-service technologies. Thus, their use intention is likely to be influenced mostly by the usefulness and ease of use aspects included in the original TAM rather than, for example, the more hedonic, social, and resource related aspects added to it in extensions like UTAUT and UTAUT2. However, like many prior IS studies, we omit the empirical examination of the linkage between use intention and actual use because this would have required a longitudinal rather than a cross-sectional study setting, which was not possible due to practical reasons.

As a theoretical framework for TR, we utilise TRI by Parasuraman (2000), which defines TR as “people’s propensity to embrace and use new technologies to accomplish goals in home life and at work” and postulates it to comprise of four co-existing dimensions defined as follows (Parasuraman & Colby, 2015):

- Optimism: “a positive view of technology and a belief that it offers people increased control, flexibility, and efficiency in their lives”
- Innovativeness: “a tendency to be a technology pioneer and thought leader”
- Discomfort: “a perceived lack of control over technology and a feeling of being overwhelmed by it”
- Insecurity: “distrust of technology, stemming from scepticism about its ability to work properly and concerns about its potential harmful consequences”

Of these four dimensions, optimism and innovativeness are hypothesised to increase TR, whereas discomfort and insecurity are hypothesised to decrease it.

TAM and TRI have also been integrated together in several prior studies. For example, in their technology readiness and acceptance model (TRAM), Lin, Shih, and Sher (2007) examined the effects of the aggregate TRI construct on TAM constructs, whereas the studies by Walczuch, Lemmink, and Streukens (2007) as well as Godoe and Johansen (2012) concentrated on effects of the four composite TRI constructs, hypothesising optimism and innovativeness to have a positive effect on PU and PEOU and discomfort and insecurity to have a negative effect on them. In this study, we follow this latter approach by examining the individual effects of the four composite TRI constructs on not only PU and PEOU, but also use intention because in the study by Lin and Chang (2011), TR has been found to affect use intention not only indirectly through PU and PEOU, but also directly. This research model is illustrated in Figure 2.

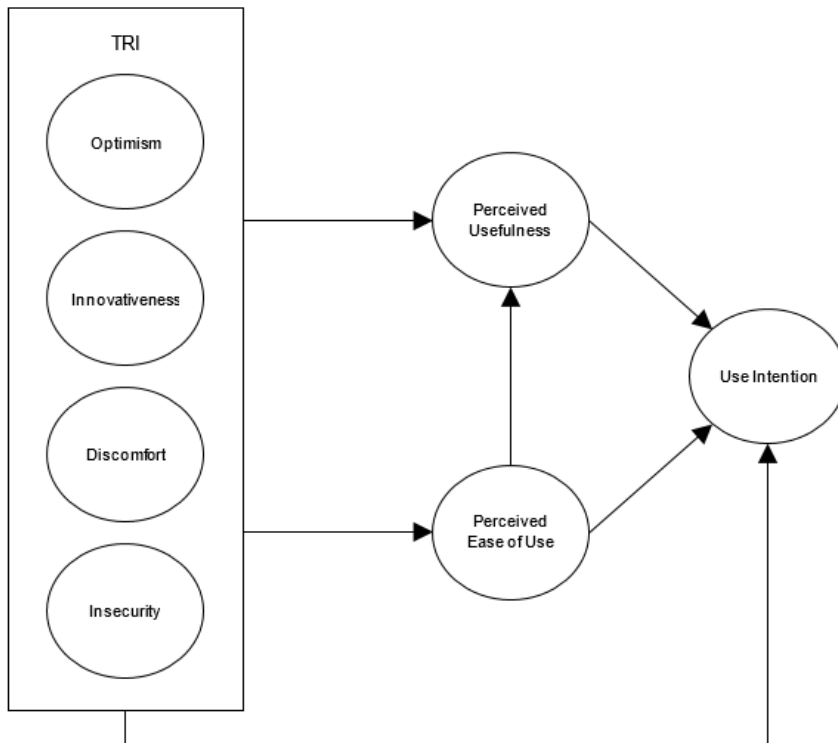


Figure 2: Research model of the study (TAM + TRI)

3 Methodology

To examine the potential age differences in TR and its effects on IS acceptance and use, we conducted a self-administered online survey targeted at Finnish consumers between December 2015 and January 2016. Due to the case context of the study, the survey was promoted via the online channels of two electric suppliers (e.g., websites, newsletters, and social media) as well as via the internal communication channels of our university and several discussion forums. To raise the response rate, also several gift cards with a total worth of 356 € were raffled among the respondents.

In the survey questionnaire, the 9 items measuring the three TAM constructs of perceived usefulness, perceived ease of use, and use intention were adapted from Davis (1989) as well as Davis, Bagozzi, and Warshaw (1989), whereas the 16 items measuring the four TRI constructs of optimism, innovativeness, discomfort, and insecurity were adapted from the TRI 2.0 scale by Parasuraman and Colby (2015). The exact wording of each item, translated from Finnish to English, is presented in Appendix A. All the items were measured on a five-point Likert scale ranging from 1 (strongly disagree) to 5 (strongly agree).

agree). The respondents were also able to skip individual items, which resulted in a missing value.

The collected data was analysed by using the IBM SPSS Statistics version 24 and the Mplus version 7.11 software. SPSS was mainly used for data preparation and preliminary analysis, whereas Mplus was used for the structural equation modelling (SEM). More information about Mplus can be found in its user's guide and technical appendices (Muthén & Muthén, 2017). As the model estimator, we used the MLR option of Mplus, which stands for maximum likelihood estimator robust to non-normal data. The missing values in the construct indicators were handled by using the FIML option of Mplus, which stands for full information maximum likelihood and uses all the available data in the model estimation. The potential age differences in the construct means and regression relationships were examined by dividing the sample into three age groups with an approximately equal age range and using multiple group analysis (MGA).

4 Results

The conducted online survey was completed by a total of 1,370 respondents. However, to promote the quality of data, 194 of them were excluded from the final sample in two phases. First, we excluded 124 respondents who had not reported being customers of any electric supplier and, thus, were not likely to be able to give reliable assessments on the online electricity services offered by the companies to their customers. Second, we also excluded an additional 70 respondents who had reported missing values in all the items measuring the three TAM constructs. This resulted in a final sample size of 1,176 respondents to be used in the model estimations. Descriptive statistics of this sample are reported in Table 1. All in all, the gender and age distributions of the sample corresponded quite well with those of the adult Finnish population at the end of 2015, which are reported in the final column of Table 1 (Statistics Finland, 2017). The main deviations were the underrepresentation of the age group of under 40 years and the overrepresentation of the age group of 40–59 years. The age of the respondents ranged from 18 to 83 years, with the mean age being 50.4 years ($SD = 15.5$ years).

Table 1: Sample statistics

	Sample (N = 1,176)		Finland
	N	%	%
Gender			
Male	631	53.7	49.2
Female	545	46.3	50.8
Age			
18–39 years	308	26.2	34.2
40–59 years	472	40.1	32.0
60+ years	396	33.7	33.9
Monthly net income			
0–999 €	213	18.1	
1000–1999 €	351	29.8	
2000–2999 €	343	29.2	
3000+ €	180	15.3	
No response	89	7.6	
Socioeconomic status			
Employed	532	45.2	
Unemployed	97	8.2	
Student	155	13.2	
Pensioner	332	28.2	
Other	60	5.1	

In the next four sub-sections, we first assess the reliability and validity of the 25 construct indicators and the seven constructs included in the research model: use intention (INT), perceived usefulness (PU), perceived ease of use (PEOU), optimism (OPT), innovativeness (INN), discomfort (DIS), and insecurity (INS). These assessments are based on a model that contains all the aforementioned constructs but does not yet contain any regression relationships between them. This is followed by the estimation of the actual research model and the examination of the potential age differences in the construct means and regression relationships.

4.1 Indicator Reliability and Validity

Indicator reliabilities and validities were evaluated by using the standardised loadings and residuals of the indicators, which are reported in Appendix B. In the typical case where each indicator loads on only one construct, it is commonly expected that the standardised loading (λ) of each indicator should be statistically significant and greater than or equal to 0.707 (Fornell & Larcker, 1981). This is equal to the standardised residual ($1 - \lambda^2$) of each indicator being less than or equal to 0.5, meaning that at least half of the variance of each indicator is explained by the construct on which it loads. As can be seen, the two indicators that were furthest from meeting this criterion were DIS1 and INS4, which both had a standardised loading of less than 0.5. Thus, after assessing that there

would be no adverse effects on the content validity of the two constructs that they were measuring, we decided to eliminate them and to re-estimate the model. In the re-estimated model, all the indicators now met the criterion or at least were very close to meeting it (DIS4 was furthest away with a standardised loading of 0.672), meaning that the re-estimated model could be considered to exhibit satisfactory indicator reliability and validity.

4.2 Construct Reliability and Validity

Construct reliabilities were evaluated by using the composite reliabilities (CR – Fornell & Larcker, 1981) of the constructs, with which it is commonly expected that each construct should have a CR greater than or equal to 0.7 in order for it to exhibit satisfactory reliability (Nunnally & Bernstein, 1994). The CR of each construct is reported in the first column of Table 2. As can be seen, all the constructs met this criterion. In turn, construct validities were evaluated by examining the convergent and discriminant validity of the constructs, which were evaluated by using the two criteria proposed by Fornell and Larcker (1981). They are both based on the average variance extracted (AVE) of the constructs, which refers to the average proportion of variance that a construct explains in its indicators. In order to exhibit satisfactory convergent validity, the first criterion requires that each construct should have an AVE greater than or equal to 0.5, meaning that, on average, each construct should explain at least half of the variance in its indicators. The AVE of each construct is reported in the second column of Table 2. As can be seen, all the constructs except for DIS and INS met this criterion. However, they

Table 2: CRs, AVEs, square roots of AVEs (bolded), and correlations of the constructs

	CR	AVE	INT	PU	PEOU	OPT	INN	DIS	INS
INT	0.951	0.866	0.931						
PU	0.881	0.712	0.722	0.844					
PEOU	0.894	0.738	0.594	0.869	0.859				
OPT	0.835	0.558	0.384	0.532	0.471	0.747			
INN	0.828	0.546	0.328	0.309	0.375	0.588	0.739		
DIS	0.730	0.475	-0.126	-0.289	-0.399	-0.398	-0.415	0.689	
INS	0.739	0.486	-0.151	-0.182	-0.202	-0.459	-0.420	0.637	0.697

In order to exhibit satisfactory discriminant validity, the second criterion requires that each construct should have a square root of AVE greater than or equal to its absolute correlation with the other constructs. This means that, on average, each construct should share at least an equal proportion of variance with its indicators than it shares with the other constructs. The square root of AVE of each construct (on-diagonal cells) and the correlations between the constructs (off-diagonal cells) are reported in the remaining columns of Table 2. As can be seen, all the constructs met this criterion, with the exception of PU and PEOU, which correlated very strongly with each other. However,

this correlation was expected due to the hypothesised effect of PEOU on PU in TAM and, thus, does not warrant the elimination of either of the constructs.

4.3 Estimation Results

Figure 3 presents the standardised estimation results of the research model, which was able to explain 56.4 % of the variance in INT, 79.3 % of the variance in PU, and 31.2 % of the variance in PEOU. The effects between the three TAM constructs followed the hypotheses of TAM, with the exception that PEOU was actually found to have a negative, although a very weak and statistically not significant, effect on INT. In contrast, the effect of PEOU on PU as well as the effect of PU on INT were both found as positive and statistically significant. This also caused the total effect of PEOU on INT, which takes into account both the direct and indirect effects ($-0.139 + 0.838 \times 0.870 = 0.590$), to be positive and statistically significant.

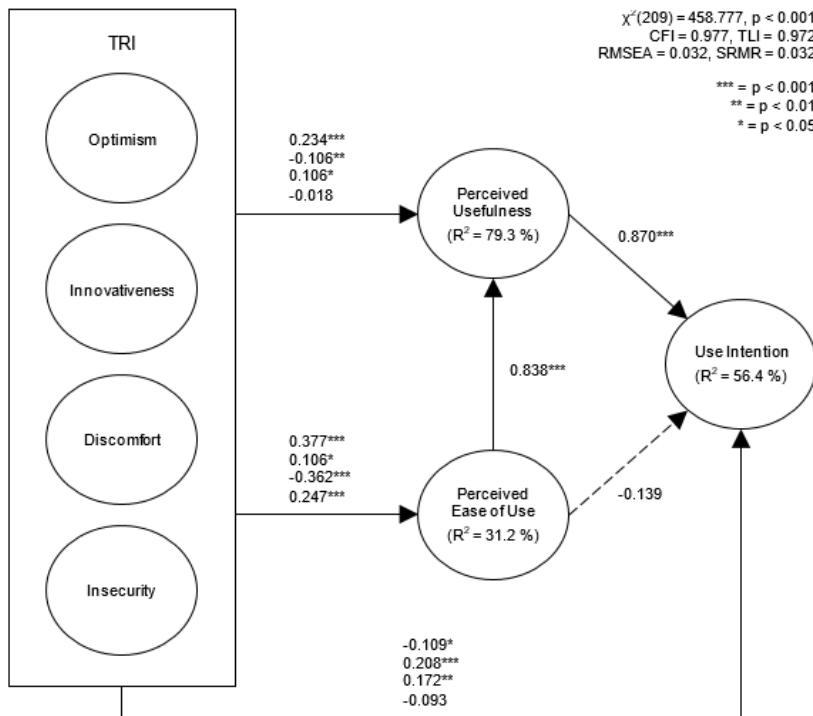


Figure 3: Estimation results of the research model (standardised)

Of the four TRI constructs, the first construct OPT was found to have positive effects on both PU and PEOU, but surprisingly a negative effect on INT, causing the total effect of

OPT on INT to be 0.316. All these effects were statistically significant. The second TRI construct INN was found to have positive effects on INT and PEOU, but surprisingly a negative effect on PU, causing the total effect of INN on INT to be 0.179. In this case as well, all these effects were statistically significant. The third TRI construct DIS was found to have a negative effect on PEOU, but surprisingly positive effects on both INT and PU. Although these two latter effects were weaker than the former one, they were all statistically significant. However, they caused the total effect of DIS on INT to be only 0.051, which was statistically not significant. Finally, the fourth TRI construct INS was found to have negative effects on both INT and PU, but surprisingly a positive effect on PEOU, which was the only one of these effects that was statistically significant. However, the total effect of INS on INT was only 0.036, which was statistically not significant.

The goodness-of-fit statistics of the model are reported in the top-right corner of Figure 3. As can be seen, the χ^2 test of model fit rejected the null hypothesis of the model fitting the data. However, instead of actual misfit, this may have been caused by the tendency of the test to underestimate the fit especially in the case of large samples and more complex models (Bentler & Bonett, 1980). For this reason, also four alternative fit indices were used to evaluate the fit: the comparative fit index (CFI), the Tucker-Lewis index (TLI), the root mean square error of approximation (RMSEA), and the standardised root mean square residual (SRMR). Their values clearly fulfilled the commonly accepted cut-off criteria (CFI \geq 0.95, TLI \geq 0.95, RMSEA \leq 0.06, and SRMR \leq 0.08 – Hu & Bentler, 1999), meaning that the model could be considered to exhibit a good fit with the data.

4.4 Age Differences in Construct Means and Regression Relationships

In order to examine the potential age differences in the construct means and regression relationships, we first divided the sample into the age groups of under 40 years, 40–59 years, and 60 years or over and then tested whether a sufficient level of measurement invariance existed across the groups to allow meaningful comparisons between them. At the minimum, the comparison of the regression coefficients requires the existence of configural and metric invariance, whereas the comparison of the construct means requires the existence of configural, metric, and scalar invariance (Steenkamp & Baumgartner, 1998). The testing followed the method formalised by Steenkamp and Baumgartner (1998), in which increasingly strict constraints on parameter equality are added across the groups and the fit of the resulting constrained model is compared to the fit of the unconstrained model. As the main test criterion, we used the χ^2 test of difference, corrected with the Satorra-Bentler (2001) scaling correction factor (SCF) due to the use of the MLR estimator. However, because the χ^2 test of difference suffers from a similar sensitivity to sample size and model complexity as the χ^2 test of model fit, also the changes in the four aforementioned fit indices were considered as suggested by Steenkamp and Baumgartner (1998). The results of the tests are reported in Table 3.

Table 3: Tests of measurement invariance and path invariance

Model	CFI	TLI	RMSEA	SRMR	χ^2	df	SCF	$\Delta\chi^2$	Δdf	p
Full configural invariance	0.979	0.975	0.032	0.040	871.605	627	1.1463	–	–	–
Full metric invariance	0.978	0.975	0.031	0.045	914.525	659	1.1444	42.862	32	0.095
Full scalar invariance	0.966	0.962	0.038	0.051	1089.681	691	1.1378	192.894	32	< 0.001
Partial scalar inv. (INN3 in –39 years)	0.970	0.967	0.036	0.048	1038.741	690	1.1379	135.439	31	< 0.001
Partial scalar inv. (INN1 in –39 years)	0.974	0.972	0.033	0.048	989.832	689	1.1383	79.800	30	< 0.001
Partial scalar inv. (INN4 in 40–59 years)	0.975	0.972	0.033	0.047	978.096	688	1.1384	66.745	29	< 0.001
Partial scalar inv. (INN2 in 40–59 years)	0.977	0.974	0.032	0.047	957.562	687	1.1388	43.584	28	0.031
Partial scalar inv. (DIS2 in –39 years)	0.978	0.975	0.031	0.046	947.172	686	1.1390	32.016	27	0.231
Full path invariance	0.977	0.975	0.031	0.056	985.110	716	1.1398	37.993	30	0.150

First, configural invariance was tested by estimating the model separately for each group while constraining only the simple structure of the model to be equal across the groups. As can be seen, the fit of this full configural invariance model remained approximately as good as the fit of the model without the group separation. Thus, the hypothesis on full configural invariance was accepted. Second, metric invariance was tested by constraining also the indicator loadings equal across the groups and comparing the fit of this full metric invariance model to the fit of the previous full configural invariance model. As can be seen, the χ^2 test suggested no statistically significant deterioration in the model fit ($\Delta\chi^2(32) = 42.862, p = 0.095$), which was supported by the four fit indices as well ($\Delta CFI = -0.001, \Delta TLI = 0.000, \Delta RMSEA = -0.001, \Delta SRMR = 0.005$). Thus, also the hypothesis on full metric invariance was accepted.

Third, full scalar invariance was tested by constraining also the indicator intercepts equal across the groups and comparing the fit of this full scalar invariance model to the fit of the previous full metric invariance model. As can be seen, in this case, the χ^2 test suggested a statistically significant deterioration in the model fit ($\Delta\chi^2(32) = 192.894, p < 0.001$), which was supported by the four fit indices as well ($\Delta CFI = -0.012, \Delta TLI = -0.013, \Delta RMSEA = 0.007, \Delta SRMR = 0.006$). Thus, the hypothesis on full scalar invariance was rejected. As a result of this, we tested for partial scalar invariance by relaxing the added constraints concerning the equality of indicator intercepts one by one based on the highest modification indices of the model and comparing the fit of these

partial scalar invariance models to the fit of the full metric invariance model. After relaxing the constraints concerning the equality of the intercepts of INN1, INN3, and DIS2 in the age group of under 40 years as well as the intercepts of INN2 and INN4 in the age group of 40–59 years, the χ^2 test did not anymore suggest a statistically significant deterioration in the model fit ($\Delta\chi^2(27) = 32.016$, $p = 0.231$), which was supported by the four fit indices as well ($\Delta CFI = 0.000$, $\Delta TLI = 0.000$, $\Delta RMSEA = 0.000$, $\Delta SRMR = 0.001$). Thus, the hypothesis on partial scalar invariance, with the indicator intercepts of INN1, INN3, and DIS2 in the age group of under 40 years as well as the indicator intercepts of INN2 and INN4 in the age group of 40–59 years varying across the groups, was accepted. Because the meaningful comparison of construct means requires at least one indicator besides the marker indicator of a construct (INN1 in the case of INN and DIS3 in the case of DIS) to have invariant indicator loadings and intercepts across the groups (Steenkamp & Baumgartner, 1998), this partial scalar invariance prevents the comparisons of the construct mean of INN between the age groups of under 40 years and 40–59 years as well as the age groups of under 40 years and 60 years or over, but still makes them possible between the age groups of 40–59 years and 60 years or over. Meaningful comparisons of the construct mean of DIS across all the age groups are also possible.

The results of the comparisons of the construct means are reported in Table 4. The first and the second columns list the differences in the construct means of the age groups of 40–59 years and 60 years or over in comparison to the age group of under 40 years as well as their statistical significance, whereas the third column lists the differences in the construct means of the age group of 60 years or over in comparison to the age group of 40–59 years as well as their statistical significance. All the reported differences are unstandardised in order to ease their interpretation. As can be seen, of the four TRI constructs, statistically significant differences were found in case of all the constructs except for INS. The age groups of 40–59 years and 60 years or over were found to score lower in terms of OPT in comparison to the age group of under 40 years, but having no statistically significant difference between each other. In contrast, the age group of 60 years or over was found to score lower in terms of INN in comparison to the age group of 40–59 years. Both of these age groups also seemed to have higher scores in comparison to the age group of under 40 years but, as mentioned above, these comparisons cannot be meaningfully conducted because of the lack of sufficient measurement invariance. Finally, the score of DIS seemed to rise with age both between the age groups of under 40 years and 40–59 years and the age groups of 40–59 years and 60 years or over. A similar difference was found also in the construct mean of INT, although the differences in the construct means of this construct as well as PU and PEOU were not the main interest of this study.

Table 4: Comparisons of construct means (unstandardised)

	40–59 years vs. –39 years	60– years vs. –39 years	60– years vs. 40–59 years
INT	0.239**	0.441***	0.202**
PU	-0.083	0.023	0.106
PEOU	-0.068	-0.058	0.010
OPT	-0.167**	-0.117*	0.049
INN	0.490***	0.278**	-0.212**
DIS	0.581***	0.807***	0.226***
INS	-0.050	-0.081	-0.030

Finally, we tested for the invariance of the regression relationships by constraining also the regression coefficients equal across the groups and comparing the fit of this full path invariance model to the fit of the previous partial scalar invariance model. As can be seen from Table 3, the χ^2 test suggested no statistically significant deterioration in the model fit ($\Delta\chi^2(30) = 37.993$, $p = 0.150$), which was supported by the four fit indices as well ($\Delta CFI = -0.001$, $\Delta TLI = 0.000$, $\Delta RMSEA = 0.000$, $\Delta SRMR = 0.010$), although there was a significant increase in the value of SRMR. Thus, the hypothesis on full path invariance was accepted, meaning that there were no statistically significant differences in the effects of the TRI constructs on the TAM constructs or on the effects of PU and PEOU on INT as well as PEOU on PU across the groups.

5 Discussion and Conclusions

In summary, the findings of this study on the potential age differences in TR and its effects on IS acceptance and use suggest several differences in the TRI constructs of optimism, innovation, and discomfort, but no differences in the effects of any of the TRI constructs on the TAM constructs of PU, PEOU, and INT. All in all, the effects of the TRI constructs on the TAM constructs were found to be in line with those found in prior studies (e.g., Walczuch, Lemmink & Streukens, 2007; Godoe & Johansen, 2012), which have also suggested optimism and innovation having the strongest effects on PU and PEOU, whereas the effects of discomfort and insecurity have typically been weaker and often statistically not significant. From a theoretical perspective, the findings of the study promote the understanding on the effects of TR on IS acceptance and use by considering also the vital role of various demographic variables like age. This promoted understanding can be utilised, for example, to better explain and predict the potential differences in the antecedents of IS acceptance and use as well as in IS acceptance and use itself between various user segments. Respectively, from a practical perspective, the findings of the study can be utilised by IS developers and marketers to promote the acceptance and use of the newly introduced systems and services especially in user segments that have traditionally been found more challenging in terms of IS adoption.

One example of such a segment is the so-called “young elderly” segment, which consists of individuals aged 60–75 years and has often been overlooked, for example, in the development and marketing of digital services in spite of its vast market potential (Carlsson & Walden, 2015; Carlsson & Carlsson, 2016). This segment can be considered as practically equivalent to the age group of 60 years or over in this study because, although this age group contained also individuals that were older than 75 years, about 95 % of the individuals in it were aged 75 years or younger. Thus, if we use the age group of 60 years or over as its proxy, the findings of the study suggest that the young elderly segment is characterised by a slightly lower level of technology optimism in comparison to the individuals aged under 40 years and also a considerably higher level of technology discomfort, especially in comparison to the individuals aged under 40 years but also in comparison to individuals aged 40–59 years. In addition, the young elderly segment seems to be characterised by a lower level technology innovativeness in comparison to individuals aged 40–59 years. Thus, in spite of being on par with the younger individuals in terms of technology insecurity, this all suggests that individuals in the young elderly segment have a somewhat lower level of TR in comparison to younger individuals, which should be taken into account if one wants to maximise the acceptance and use of the newly introduced systems and services in this user segment. Of the aforementioned differences, the most important ones are obviously the differences concerning technology optimism and innovation because these two TRI constructs were the ones that were found having a statistically significant total effect on the intention to use IS when considering both the direct and indirect effects on it.

Consequently, when developing and marketing new systems and services to the young elderly segment, special attention should be paid to making them as easily approachable as possible for also people who are typically not at the forefront of adopting new technological innovations as well as to highlighting the benefits that the usage of these new systems and services can bring to their everyday lives. The strategies that aim at doing this may include, for example, marketing and advertising campaigns as well as various technological solutions, such as the usage of tutorials, which lower the threshold to trial the systems and services and make their overall learning curve less steep. The implementation of such strategies is likely to result in two synergetic advantages. First, in the short term, they are likely advance the adoption of the systems and services amongst the users in the young elderly segment with a lower level of TR. Second, in the long term, through this adoption, they are also likely to advance the level of TR in the whole young elderly segment, especially if the use experiences of the adopted systems and services are positive and they are able to fulfil the user expectations towards them.

6 Limitations and Future Research

This study can be seen to have three main limitations. First, the study was conducted by analysing the survey data collected from only Finnish consumers, which obviously limits the generalisability of its findings to other countries and cultures. Second, the study was conducted in the case context of online electricity services, which poses limitations on

the generalisability of its findings concerning the effects of the TRI constructs on the TAM constructs, but not on the generalisability of its findings concerning the mean differences in the TRI constructs themselves, since their measurement was conducted independently of the case context in question. Finally, the third main limitation of the study stems from the selection of TAM as the theoretical framework for conceptualising and operationalising IS acceptance and use as well as its main antecedents, which obviously omits the antecedents that have been added to the original TAM in its subsequent extensions, such as UTAUT (Venkatesh et al., 2003) and UTAUT2 (Venkatesh, Thong & Xu, 2012). However, as already stated in Section 2, we consider this selection well-justified because of the utilitarian case context of the current study.

Future studies should aim to address the aforementioned limitations by replicating the study also in other countries and cultures as well as in the case context of other types of IS. The selection of the case context should also be reflected in the selection of the theoretical framework for conceptualising and operationalising IS acceptance and use as well as its main antecedents. In addition to age, we also encourage future studies to concentrate on examining the potential differences in terms of other interesting and important demographic variables, such as gender and income.

Appendix A: Indicator Wordings

- INT1 I intend to use the e-services in the following year.
- INT2 I plan to use the e-services in the following year.
- INT3 It is likely that I will use the e-services in the following year.
- PU1 Using the e-services to manage my electricity affairs would be convenient.
- PU2 Using the e-services would make it easier for me to manage my electricity affairs.
- PU3 I would find the e-services useful in managing my electricity affairs.
- PEOU1 I would find the e-services easy to use.
- PEOU2 My interaction with the e-services would be clear and understandable.
- PEOU3 Learning to use the e-services would be easy for me.
- OPT1 New technologies contribute to a better quality of life.
- OPT2 Technology gives me more freedom of mobility.
- OPT3 Technology gives people more control over their daily lives.
- OPT4 Technology makes me more productive in my personal life.
- INN1 Other people come to me for advice on new technologies.
- INN2 In general, I am among the first in my circle of friends to acquire new technology when it appears.
- INN3 I can usually figure out new high-tech products and services without help from others.
- INN4 I keep up with the latest technological developments in my areas of interest.
- DIS1 When I get technical support from a provider of a high-tech product or service, I sometimes feel as if I am being taken advantage of by someone who knows more than I do.
- DIS2 Technical support lines are not helpful because they do not explain things in terms I understand.
- DIS3 Sometimes, I think that technology systems are not designed for use by ordinary people.

- DIS4 There is no such thing as a manual for a high-tech product or service that is written in plain language.
INS1 People are too dependent on technology to do things for them.
INS2 Too much technology distracts people to a point that is harmful.
INS3 Technology lowers the quality of relationships by reducing personal interaction.
INS4 I do not feel confident doing business with a place that can only be reached online.

Note: The indicators of OPT, INN, DIS, and INS comprise the TRI 2.0 scale, which is copyrighted by A. Parasuraman and Rockbridge Associates, Inc., 2014. It may be duplicated only with a written permission from the authors.

Appendix B: Indicator Loadings and Residuals

	Loading	Residual
INT1	0.952***	0.093***
INT2	0.903***	0.184***
INT3	0.935***	0.125***
PU1	0.868***	0.247***
PU2	0.838***	0.299***
PU3	0.825***	0.319***
PEOU1	0.887***	0.213***
PEOU2	0.871***	0.242***
PEOU3	0.818***	0.332***

	Loading	Residual
OPT1	0.749***	0.439***
OPT2	0.735***	0.459***
OPT3	0.759***	0.424***
OPT4	0.745***	0.445***
INN1	0.771***	0.406***
INN2	0.762***	0.420***
INN3	0.726***	0.473***
INN4	0.696***	0.516***

	Loading	Residual
DIS1	0.585***	0.658***
DIS2	0.692***	0.521***
DIS3	0.691***	0.523***
DIS4	0.648***	0.581***
INS1	0.690***	0.523***
INS2	0.689***	0.526***
INS3	0.672***	0.548***
INS4	0.514***	0.736***

*** = $p < 0.001$, ** = $p < 0.01$, * = $p < 0.05$

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Local Online Platforms – Surviving in a Global Market

ANTON MANFREDA, PETER TRKMAN, ALEŠ GROZNIK & JURE ERJAVEC

Abstract Many companies are trying to change their existing business models and start with the digital initiative. Online business will continue to grow; however, in the digital world where almost every organization is present online, the critical success factors for surviving on the market are more than needed. The purpose of the research is thus to study the factors influencing the success/failure of local online platforms' providers in competition with global providers. The fact that some local providers are even market leaders in a local environment while many others have failed implies that there exist some specific factors determining the success of global competitor in a local market. The study will present a valuable opportunity particularly for new companies or existing companies that are deciding about launching new online services in order to judge whether there is a potential for their service on the market and which factors they should consider before starting the competition with global market leaders.

Keywords: • Globalization • Local online platforms • Global online platforms • Digitalization • Research program •

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1 Introduction

Internet with its promise for lowering the cost, potential for increasing the quality of services and efficiency enabled a rapid development for e-business. Nevertheless, the possibility that anyone can have a web page with almost no investment has presented a huge opportunity for creating and advertising business online. The promise of reaching a global market no matter neither the size nor location of the organization seems to raise the hope of many companies. Therefore, in the last few decades almost every company has been trying to leave some presence in the World Wide Web. Mostly due to the promise of “no matter how small you are there is a whole world for you”.

The globalization of markets was believed to supplant the multinational commercial and corporations. The future was in offering the same things in the same way everywhere since the global corporations should operate as if the whole world is a single entity (Levitt, 1993). Technological progress made this future even more real. Nowadays, e-commerce is having a larger share of commerce in more and more regions (Barns, 2016).

Yet, the promise of internet and the possibility to reach the whole world was not equally successful for all. In the digital era there are again some global organizations dominating the world, while contrary there are several market leaders in local markets that are completely unknown outside their local region. The same applies to the providers of different online platforms offering vouchers, tourism services, auctions and web browsers or social media as well. Despite having global online platform providers like Groupon, Airbnb, e-bay, Google, and Facebook, there are several local online providers in different regions more than successfully facing with the global well known competitors within their regional borders.

The purpose of the research is thus to examine the factors that influence the success of local online platforms. The aim is to identify the reasons why some local online platform providers that have been market leaders failed, while other local providers remained successful or even a market leader in a local environment despite the existence of global well-known providers.

This research-in-progress paper will present a research program together with the methodological steps that will be performed in our research. Therefore, the paper is divided into two main parts. Firstly, a short literature review is presented followed by the methodology and a research plan. Finally, some concluding remarks and future research possibilities are outlined.

2 Literature review

2.1 Digitalization

The digitization initiative began decades ago; however, it has become more prevalent in the last years and will certainly have an important effect in the next decades (Gerth & Peppard, 2016). It is becoming the most significant technological trend with global consequences (Leviäkangas, 2016) since it is affecting individuals, organizations, communities and entire regions. It is believed that digital transformation will change business processes, customer experience and the entire business models due to the more and more information available for individuals and organizations; and therefore, enables to perform activities even more efficiently (Sganzerla, Seixas, & Conti, 2016).

It was even claimed decades ago that business models from the industrial age were not suitable anymore to deal with the (at that time) forthcoming challenges of the information age (Venkatraman & Henderson, 1998). The same may be valid today, where past business models are not suitable to deal with the challenges of the digital transformation era. Moreover, innovative business models were namely claimed to be one of the most important reasons for the success of several organizations tightly connected to the online business like Amazon, Microsoft or eBay (Afuah, 2004).

However, is it merely about the innovative business models? Are innovative models enough to penetrate to global market or to become a global leader? Digitization is spreading out in almost all industries sectors; and therefore, it is anticipated that there will be even more “online” competition in a global market. Hence, the question about important factors needed for local companies to survive in a digital world becomes more important as ever before.

2.2 Local versus global providers

The debate about local and global providers has its roots in the glocalization concept. It has been denoted as a mixture of globalization and localization (Robertson, 1995) balancing the universal of globalization and the particular of localization.

Ideas of glocalization are mainly associated with the international contexts; however, glocalization can be also related to the understanding of cultural differences within regional and national boundaries (Breuch, 2015). Several key areas were distinguished in relation to when and how different cultures access information or use the technologies, including literacy, linguistic difference, physical environment, cultural norms and technological infrastructure (Best & Smyth, 2011). All these areas and specifics should be considered when launching new web services or online platform in local market.

Although there are significant cultural differences among nations, some providers succeeded in becoming a global platform provider. As it evident from Figure 1 presenting the market share of leading search engines from January 2010 to October 2016, there is almost no place for competing providers. However, examining the state in different regions suggests that despite having a global market leader, there are local market champion like Baidu in China, Naver in South Korea or Yandex in Russia (ReturnOnNow, 2015). Even in Japan the second strongest provider (Yahoo Japan) is with 40% share much above the global average, while Google with its 57% much below the average.

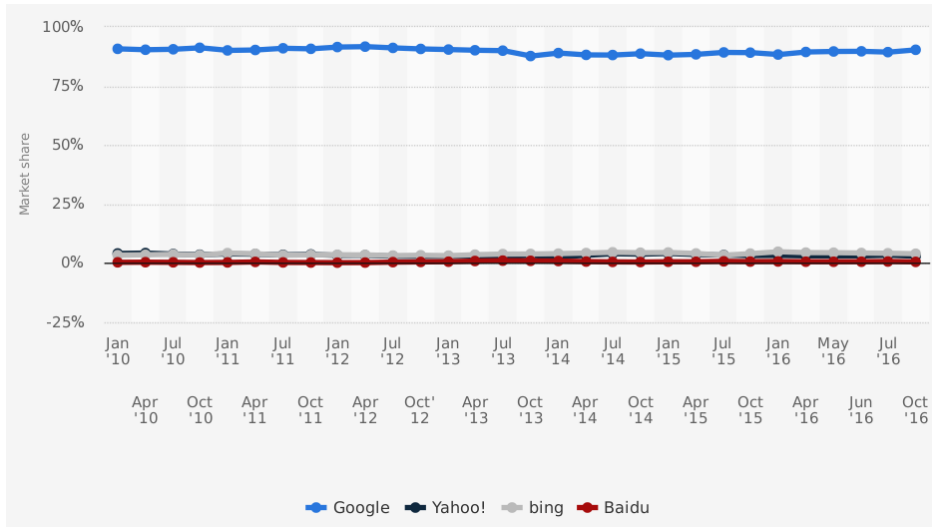


Figure 1: Global market share of search engines 2010-2016 (StatCounter, 2016)

At the moment there is an increasing pressure on global services providers to grow along with the needs of their customers in order to offer classier range of services both in terms of extent and geographic coverage (Pollock, 2017).

3 Research Program

We decided to delve into this issue with a research program that will identify and validate the factors that influence the likelihood of the success of a local online platform and build a framework for successful deployment of local online platforms when competing with global online platforms. Different research methods will be used in several steps.

The first step of our research will be a focus group by which we will be able to clearly define the outline of our further research. The focus groups are restricted to early, exploratory stages of research (Lunt & Livingstone, 1996). They offer an insight to the discussed topic (Grudens-Schuck, Allen, & Larson, 2004). The focus group will consist

of providers/founders of online platforms and will thus provide an insight into reasons for (lack of) success of local online platforms.

The second step will be based on the literature review and results from focus groups. We will conduct a Delphi study with the goal to identify the factors for success of local online platform providers when competing with global online platform providers. Delphi study is a group iterative method that uses controlled opinion feedback group of respondents (Dalkey & Helmer, 1963). It can be used in management disciplines to shape a group consensus of relative importance of issues by using a ranking system (Schmidt, 1997). It can also be used as a method for concept or framework development (Okoli & Pawlowski, 2004).

The Delphi study will include two separate groups. One group will be practitioners from the field of online platforms while the other group will be the experts/researchers. This split panel approach is advocated because of the ability to create a joint reality shared by both groups (Linstone & Turoff, 1975). The number of steps in the Delphi study will depend on how fast the consensus will be reached. While some authors suggest that a certain percentage of participants in the study need to reach consensus (the percentages differ), other authors suggest a more qualitative approach to estimate when consensus is reached (Hasson, Keeney, & McKenna, 2000). The Delphi study will be designed based on the principles presented in (Linstone & Turoff, 1975).

After identifying the factors for success of local online platform providers, we will conduct several in-depth case studies of local online platforms. Case studies are used in research which is still in the process of understanding, detection and characterization (Stuart, McCutcheon, Handfield, McLachlin, & Samson, 2002). The case studies will be used to verify the identified factors for success of local online platforms by analysing real companies.

4 Conclusion

The companies that are offering local online platforms often have to compete with global online platform providers. The purpose of the research is to identify and examine the factors that influence the success of local online platforms when competing with global online platforms. Contrary, the research will also ease the understanding when creating local online platforms has no potential. Our research will include several steps that will help us rigorously identify the factors and verify them.

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Conceptualizing Digital Transformation in Business Organizations: A Systematic Review of Literature

RESEGO MORAKANYANE, AUDREY GRACE & PHILIP O'REILLY

Abstract Digital Transformation has gained great research interest in both academia and practice. While existing literature demonstrates new levels of research interest in the area and how business leaders have engaged in digital transformation journeys, there is evidence of a lack of common understanding of this concept. Both research and practice do not have unified views of the fundamental concepts of digital transformation. To this regard, we demonstrate how a systematic literature review was carried out to conceptualize this phenomenon. Using a concept centric matrix, we discuss the current state of the art literature of the concept by describing it in terms of what it is, the characteristics, drivers, impacts and transformed areas. Inconsistencies in the definition and other factors are identified. Towards a more comprehensible approach to understanding this phenomenon, we argue for the reconciliation of the literature and propose a new general and inclusive digital transformation definition. Avenues for further research on digital transformation of business organizations are also shared.

Keywords: • Digital Transformation • Digital Technologies • Concept Centric Matrix • Literature Review •

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1 Introduction

The advent of information and digital technologies - the time characterized by use of information and communication technologies (Siemens 2014) as well as mushrooming of new digital technologies (Resnick 2002), their adoption and use (intended or unintended), presents a new form of transformation: digital transformation (Hanna 2016). In business organizations, this form of organizational transformation, which is technology-enabled, is concerned with the use of information and digital technologies to impact different aspects of the organization. For example, organizations adopt emerging technologies such as social media, mobile technologies, internet of things, cloud technologies, big data analytics, etc. (Resnick 2002, Fitzgerald et.al. 2013) to enhance their daily operations (Aral et.al. 2013, Oestreicher-Singer & Zalmanson 2013, Hanna 2016). As a result, these technologies transform the way business entities operate, creating value and bringing different experiences to various stakeholders involved.

Several studies have been carried out to demonstrate how organizations and industries have adopted digital technologies as well as demonstrating their transformational impacts. An MIT Sloan Management Review Research Report (2013) revealed that 78% of executives and managers across various industries, believed achieving digital transformation would be critical to their organizations. Another study by Harvard Business Review Analytics Services (2014) revealed that 50% of business and technology leaders said their organizations were already missing out on new technology-enabled business opportunities. Berman (2012) argues that the key transformational opportunities are: (i) creating new business models; (ii) improving operational processes; and (iii) enhancing customer experiences. Bharadwaj et.al. (2013) reflect on digital transformation era as a time for organizations to rethink the role of IT strategy from that of a functional level strategy to one that integrates IT strategy and business strategy. All these indicate how organizations are increasingly being involved in digital transformation. In fact, in today's digital era, digital transformation has become an everyday agenda item in business boardrooms. As a result of this, the digital transformation phenomenon has created new research interest across different disciplines, (Bharadwaj et.al. 2013, Lucas et.al. 2013, Sertia et.al. 2013).

Although substantial amounts of work is ongoing in this area, this study reveals that research carried out in this regard is still at a nascent stage. There are indications of an immature literature landscape coupled with a limited understanding of the phenomenon. The few literature review papers on digital transformation that were encountered during our search (cf. Besson & Rowe 2012, Cha & Lee 2013, Henriette et.al 2015, Piccinini et.al 2015) indicate a mismatch and conflicting views in the conceptualization of some basic fundamentals of the phenomenon. Constructs such as a definition of the phenomenon, characteristics, drivers, etc. remain vague. In fact, these literature reviews call for more research, especially on the reconciliation and expansion of the digital transformation literature.

As per Besson & Rowe (2012) and Cha & Lee (2013) we acknowledge inconsistencies in the digital transformation literature and further argue for its reconciliation and expansion. To trigger this discourse, Westerman et.al. (2014) ask whether digital transformation is the solution to emerging business challenges in the digital era or is another marketing buzz word. A huge challenge remains in the lack of a reconciled definition and fundamental elements of the literature. Many existing studies out view digital transformation as totally different things. For instance, while some authors view a slight technology-enabled change such as implementing a new ERP System as digital transformation, others believe that digital transformation is actually a more radical and evolutionary process that takes place over time (Wang, et.al. 2016, Janowski 2015, Loebbeck & Picot 2015). While some researchers associate digital transformation with business models and strategy, others view digital transformation as a paradigm or as a process (Berman 2012, Berman & Marshall 2014).

In light of this, we argue for the extension of literature that describes and articulates the phenomenon of digital transformation; what it is; how it behaves; what drives it; what impacts it creates, as well as where the impacts are felt. We believe that a solid foundation for this phenomenon is required. To this end, a systematic literature review is carried out and a concept centric matrix is developed. Drawing on this matrix, a more inclusive and general definition is constructed. The selection of keywords in this comprehensive definition of digital transformation is explained and avenues for further research are also highlighted.

2 Methodology

A scholarly literature search was performed with the aim of retrieving credible peer reviewed and academic research articles in this area (see Table 1).

Table 1: Using Gass et.al.(2014)'s 4 Phase Literature Analysis Approach

Phase	How it was used
Phase 1: Searching Process search for academic journals & conference papers using academic databases	Search keywords include: “digital business strategy”, “digital transformation”, “digitalization”, “IT-enabled Organizational Transformation”, “IT-enabled Enterprise Transformation”; “digital technologies” Search using keywords and Boolean operators: “digital transformation AND digital business strategy”; “IT enabled transformation AND enterprise transformation”; “enterprise transformation AND digital technologies”; “organizational transformation AND digital transformation”; etc.
Phase 2: Screening Process screening conditions were developed and used to focus results obtained from the searching process	Conditions used to narrow the search include: 1. Articles should be written in English 2. Articles should be published in 2010 or after 3. Articles should have at least one of the keywords above listed as part of the keywords in the abstract
Phase 3: Clustering Process clusters were developed based on thematic areas – constructs	Thematic Areas Identified include: 1. What is Digital Transformation 2. Characteristics of Digital Transformation 3. Drivers of Digital Transformation 4. Impacts of Digital Transformation 5. Transformed Areas
Phase 4: Analysis Process thematic analysis technique was used to synthesize articles to create a body of literature using constructs above	Thematic Analysis Technique used to develop the Concept Centric Matrix: See Table 3

Articles retrieved were scrutinized to extract similar traits and patterns that build up towards the phenomenon, where variables such as: “description of what is”; “characteristics”; “drivers”, “impacts” and “transformed areas” were identified as constructs to the fundamental conceptualization of the phenomenon. The concept centric matrix process (Webster & Watson, 2002) was adopted to synthesize the retrieved articles. This process was carried out within the period of March to October 2016 using Gass, et.al. (2015)'s 4 Phase Approach to literature analysis. Table 1 below illustrates the approach and how it was utilized in this review.

The literature search yielded many articles. Criteria from the screening processes were applied to narrow the search and set the final inclusion and exclusion criteria. For searches that yielded many results, the search was sorted according to relevance and only first 10 results were considered. On analysing the metadata, articles that did not meet the criteria set were excluded. While there was a deliberate focus on articles published in the basket of 8, articles from other peer reviewed sources and academic conferences were also considered. Articles included in the final selection were then downloaded and perused in more detail.

Analysis revealed that some of the articles retrieved stated the definition of digital transformation, also giving different descriptors such as characteristics, drivers, impacts and transformed areas while others gave a perspective approach of what digital

transformation could mean in specific contexts. Table 2 summaries the type of articles downloaded, defining each type, the number of articles in each type that provided the definition of digital transformation as well as the total number of articles downloaded for each type.

Table 2: Articles Retrieved

Type of Article	Description	Definition provided	No Definition	Total
Management Reviews	Articles obtained from Business and Management Review publications of reputable business schools, centre of studies or a collaboration	2	15	17
Academic Conferences & Journals	Articles obtained from different peer reviewed academic conferences and journals	9	27	36
Total		11	42	53

3 Digital Transformation: The Current Situation

An in-depth analysis of the articles was carried out to determine how authors describe digital transformation. In this process, retrieved articles were used to identify the definition, characteristics, drivers, impacts and the transformed areas as articulated by the authors. A concept centric matrix was developed to capture the different variables for each construct as they are identified. Table 3 is an illustration of the concept centric matrix developed from analysing these articles.

Table 3: Digital Transformation - Concept Centric Matrix

What is Digital Transformation?	
Strategy	Bharadwaj, et.al. (2013); Matt, et.al. (2015); Mithas, et.al. (2013); Hansen & Sia (2015); Granados & Gupta (2013);
Process	Agarwal, et.al. (2010); Berman & Marshall (2014); Bharosa, et.al. (2013); Janowski (2015); Kreutzer (2014); Loebbecke & Picot (2015); Stieglitz & Brockmann (2012); Tamm, et.al. (2015); Wang, et.al. (2016); Hansen et.al. (2011);
Business Model	Henriette, et.al. (2015); Stieglitz & Brockmann (2012);
Paradigm Shift	Berman & Marshall (2014); Piccinini (2015a);
What are its Characteristics?	
Radical	Liu et.al. (2011); Berman (2012); Berman & Marshall (2014); Westerman et.al. (2011);
Disruptive	Berman (2012); Berman & Marshall (2014); Granados & Gupta, (2015); HBR Analytics Services (2014); Fitzgerald, M. et.al. (2013);
Evolutionary/continuous	Loebbeck & Picot (2015); Janowski (2015); Wang et.al. (2016); Liu et.al. (2011);
Complex	Janowski (2015); Bharosa et.al. (2013); Matt et.al. (2015); Agarwal (2010);
What are the Drivers of Digital Transformation?	
Digital Technologies	Agarwal, et.al. (2010); Berman (2012); Bharadwaj, et.al. (2013); Bharosa, et.al. (2013); Janowski (2015); Kreutzer (2014); Luna-Reyes & Gil-Garcia (2014); Mithas, et.al. (2013); Lucas, et.al. (2013); Stieglitz & Brockmann (2012); Setia, et.al. (2013); Wang, et.al. (2016); Berman & Marshall (2014); Loebbecke & Picot (2015); Westerman et.al. (2011);
Digital Capabilities	Berman & Marshall (2014); Loebbecke & Picot (2015); Matt, et.al. (2015); Schuchmann & Seufert (2015); Tamm, et.al. (2015); Wang, et.al. (2016); Westerman et.al. (2011);
Strategies	Berman & Marshall (2014); Bharadwaj, et.al. (2013); Matt, et.al. (2015); Stieglitz & Brockmann (2012); Tamm, et.al. (2015); Mithas, et.al. (2013);
Business Models	Agarwal, et.al. (2010); Berman & Marshall (2014); Bharadwaj, et.al. (2013); Janowski (2015); Loebbecke & Picot (2015); Luna-Reyes & Gil-Garcia (2014); Matt, et.al. (2015); Mithas, et.al. (2013); Schuchmann & Seufert (2015); Tamm, et.al. (2015); Stieglitz & Brockmann (2012);
Value Chain	Agarwal, et.al. (2010); Berman & Marshall (2014); Bharosa, et.al. (2013); Janowski (2015); Stieglitz & Brockmann (2012); Tamm, et.al. (2015); Wang, et.al. (2016);
What are the Key Impacts of Digital Transformation?	
Value Creation: Reshapes Realign Redefine Integrate Collaboration	Matt, et.al. (2015); Mithas, et.al. (2013); Schuchmann & Seufert (2015); Berman (2012); Bharadwaj, et.al. (2013); Luna-Reyes & Gil-Garcia (2014); Stieglitz & Brockmann (2012); Johnson & Lederer (2010); Berman & Marshall (2014); Chen et.al (2013); Bharosa et.al. (2013); Wang, et.al. (2016); Agarwal, et.al. (2010); Buschmeyer et.al. (2016); Westerman et.al. (2011);
Operational Efficiency: Optimize Processes, Omni Channel; Agility; Improved Decision Making Structural Change	Bharadwaj, et.al. (2013); Luna-Reyes & Gil-Garcia (2014); Matt, et.al. (2015); Mithas, et.al. (2013); Schuchmann & Seufert (2015); Lucas, et.al. (2013); Setia (2012); Kreutzer (2014); Stieglitz & Brockmann (2012); Tamm et.al. (2015); Berman & Marshall (2014); Loebbeck & Picot (2015); Hansen & Sia (2015); Janowski (2015); Bharosa et.al. (2013); Wang et.al. (2016); Agarwal et.al. (2010); Berman & Marshall (2014); Chen et.al (2013); Westerman et.al. (2011);
Create Competitive Advantage	Bharadwaj, et.al. (2013); Lucas, et.al. (2013); Matt, et.al. (2015); Schuchmann & Seufert (2015); Kreutzer (2014); Stieglitz & Brockmann (2012); Chen et.al (2013); Westerman et.al. (2011);
Improved Relationships: Enhance	Bharadwaj, et.al. (2013); Luna-Reyes & Gil-Garcia (2014); Matt, et.al. (2015); Schuchmann & Seufert (2015); Bharosa et.al. (2013); Wang et.al. (2016);

Customer Experiences; Engagement	Berman (2012); Luna-Reyes & Gil-Garcia (2014); Matt, et.al. (2015); Piccinini et.al. (2015a); Berman & Marshall (2014); Loebbeck & Picot (2015); Chen et.al (2013); Westerman et.al. (2011);
Where are these Impacts Felt (Transformed Areas)?	
Business Models	Berman (2012); Westerman et.al. (2011); Agarwal, et.al. (2010); Berman & Marshall (2014); Bharadwaj, et.al. (2013); Janowski (2015); Loebbecke & Picot (2015); Luna-Reyes & Gil-Garcia (2014); Matt, et.al. (2015); Mithas, et.al. (2013); Schuchmann & Seufert (2015); Tamm, et.al. (2015); Hansen et.al. (2011); Chen et.al (2013);
Operational Processes	Bharadwaj, et.al. (2013); Lucas, et.al. (2013); Luna-Reyes & Gil-Garcia (2014); Matt, et.al. (2015); Mithas, et.al. (2013); Schuchmann & Seufert (2015); Westerman et.al. (2011); Hansen et.al. (2011); Berman & Marshall (2014); Chen et.al (2013);
Customer Experiences	Berman (2012); Luna-Reyes & Gil-Garcia (2014); Matt, et.al. (2015); Schuchmann & Seufert (2015); Piccinini et.al. (2015a); Berman & Marshall (2014); Loebbeck & Picot (2015); Luna-Reyes & Gil-Garcia (2014); Westerman et.al. (2011); Gray et.al. (2013);
Employees	Schuchmann & Seufert (2015); Tamm et.al. (2015); Hansen & Sia (2015); Luna-Reyes & Gil-Garcia (2014); Hansen et.al. (2011); Janowski (2015);
Culture	Schuchmann & Seufert (2015); Hansen & Sia (2015); Berman & Marshall (2014);
Infrastructure	Tamm et.al. (2015); Hansen & Sia (2015); Kohli & Johnson (2011);

Table 4 lists the definitions obtained from the 11 articles (in Table 2), which were analysed to establish a pattern in the structure of the definitions. Each definition is analysed paying attention to: (i) what keywords and variables have been used to describe this concept, (ii) identifiable patterns that relays how these keywords and variables have been used to develop the definitions.

Table 4: Digital Transformation - Current Definitions

Authors	Definition
Liu et.al. (2011);	"the integration of digital technologies into business processes"
Bharadwaj et.al. (2013);	"an organizational strategy formulated and executed by leveraging digital resources to create differential value"
Fitzgerald et.al. (2013);	"the use of digital technologies to enable major business improvements"
Lucas et.al (2013);	"fundamentally altering traditional ways of doing business by redefining business capabilities, processes and relationships"
Mithas et.al. (2013);	"the extent to which an organization engages in any activity of IT"
Westerman et.al. (2014b);	"the use of technology to radically improve performance or reach of enterprises"
Henriette et.al. (2015);	"a business model driven by the changes associated with the application of digital technology in all aspects of human society"
Piccinini et.al. (2015);	"characterized by the use of new digital technologies to enable significant business improvements"
Schuchmann & Seufert (2015);	"realignment of technology and new business models to more effectively engage digital customers at every touchpoint in the customer experience life cycle"
Chanias & Hess (2016);	"reflect the pervasiveness of changes induced by digital technologies throughout an organization"
Hess et.al. (2016)	"concerned with the changes digital technologies can bring about in a company's business model, which result in changed products or organizational structures or in the automation of processes"

A further in-depth analysis of both concept centric matrix (Table 3) and the current definitions (Table 4) revealed that there are significant differences regarding how digital transformation is conceptualised. Nevertheless, a common pattern has been identified in the structure of digital transformation definition, which suggests how the keywords and variables have been used to describe the concept. To qualify and refine this pattern, an iterative process was carried out several times, alternating different variables and keywords in order to attain a more precise yet general structure of the definition. After several iterations, we propose a pattern that suggests that digital transformation is:

"... something with certain characteristics; that is driven by something; to create certain impacts; on certain aspects of the organization"

Table 5 examines the validity of this proposed definition structure using examples from current definition and concept centric matrix.

Table 5: Examining Validity of the Proposed Digital Transformation Definition Structure. Source: Bharadwaj et.al. (2013)

Source	Bharadwaj et.al. (2013)	Westerman et.al. (2014b)	Hess et.al. (2016)	Concept Centric Matrix
	an organizational strategy formulated and executed by leveraging digital resources to create differential value	the use of technology to radically improve performance or reach of enterprises	concerned with the changes digital technologies can bring about in a company's business model, which result in changed products or organizational structures or in the automation of processes	
...is something...	<i>Strategy</i>	???	???	strategy; process; business model; paradigm shift; etc.
...with certain characteristics...	???	Radically	Change	Radical; Disruptive; Evolutionary; continuous, etc.
...that is driven by something...	formulated and executed by <i>leveraging digital resources</i>	Technology	Digital technologies	digital technologies ; digital capabilities; business models; strategies; etc.
...to create certain impacts...	<i>to create differential value</i>	Improve performance	Automation	value creation; enhanced relationships; omni-channel access; optimize; saving; etc.
...on certain aspects of the organization	Organization wide	Enterprise wide	Business model; Products; Organizational structures; Processes	Operational processes; business models ; strategies; customer experiences ; value chain; etc.

Using the proposed definition structure, we illustrate the inconsistencies in the literature of this phenomenon using both concept centric matrix and current definitions. In order to reconcile these differences and ‘square this circle’, we draw upon these tables to construct an inclusive and general digital transformation definition.

3.1 Characteristics of Digital Transformation

The literature assessed views characteristics of digital transformation as behavioural traits displayed by this phenomenon. Different authors used adjectives to describe these traits, perhaps because of the long term impacts digital transformation have on business organizations. From the analysis, only a few of the articles described the digital transformation phenomenon in terms of its behavioural characteristics. However, notwithstanding the few descriptions, these characteristics could not be ignored because they serve a purpose of putting into perspective the extent of the impact that is created during the transformation: whether the impact is small or large, gradual or abrupt, etc. In

this instance, the analysed literature characterizes the behaviour of digital transformation as radical, disruptive, evolutionary, continuous and complex. We propose that for a more inclusive and comprehensible description, digital transformation displays more of an evolutionary trait.

3.2 Drivers of Digital Transformation

Drivers of digital transformation are attributes that influence and enable the process of digital transformation to take place. Although insufficient, the existing literature identified attributes such as digital capabilities and maturity, digital technologies, strategies, business models etc. as factors that drive the digital transformation agenda in organizations. Ezeokoli et.al. (2016) notices that several studies have articulated digital transformation drivers as: profitability and new revenue growth, customer satisfaction, increased operational efficiency, convenience and the same high-quality technical standard, increase business agility, increased employee productivity and competitive advantage. While it was also observed that in some instance there was an overlap between digital transformation drivers and impacts, caution was exercised to separate the two such that drivers remain attributes that influence and enable while impacts are emerging benefits realised from the process of digital transformation. However, while it is arguable which attribute would be possessing more digital drive, we argue that digital technologies play a vital role in the digital transformation process. We believe the capabilities that these technologies possess, coupled by other factors, such as culture, strategy and digitally savvy human capital is what enables the digital transformation process. Kane et.al. (2015a) argue that simply using digital technologies to drive the digital transformation process is not enough and that it also uses digital capabilities, strategies, culture and talent development.

3.3 Impacts of Digital Transformation

Digital transformation impacts are the effects that business organizations experience as a result of the transformation process. While analysed literature has not classified these impacts, we categorize these impacts into customer-focused and organization-focussed categories, customer focused are the effects that impact customers and organization-focussed impact the organization itself. We further argue that these impacts can have a positive or negative effect on both the customer and the organization. Different studies have used different verbs to describe actions that digital transformation has on organizations, however we believe the ultimate impact that organizations want to leverage on digital transformation is value creation – to both the organization and customers.

3.4 Transformed Areas

Different authors identify different areas which are impacted during the digital transformation process. Westerman et.al. (2014b) alludes that digital transformation takes place in three key areas of the firm: customer experience, operational processes and business models, suggesting that the effects of digital transformation in business organizations are felt in these three key areas. While Westerman et.al. (2014b) allege that these three key areas are what business leaders focus the enterprise's transformation efforts towards, from an "orchestrating the organization" lens, it is established that not all key elements that ensure a perfect organizational orchestration have been included. For instance, Bouee (2015) argue that employees should not be left out in the digital transformation journey. Other researchers, including Matt et.al. (2015), Bharadwaj et.al. (2013), etc. demonstrate how digital transformation impacts organizational structure, while Piccinini (2015a), Loebbeck & Picot (2015), etc. allude that digital transformation impacts relationships. In determining the transformed areas, we however argue that as the benefits of digital transformation are to be felt by both the organization and the customers, it is important to ensure that the transformed areas considered for the general description of digital transformation should be inclusive of both organization and customer. We therefore propose that Westerman et.al. (2014b)'s three key transformed areas are more general and inclusive of both the organization and customer.

The process was repeated several times, alternating different keywords and variables to ensure rigor and relevance in the proposed definition. It is after iterating several times that the definition below was proposed: Digital transformation is:

“an evolutionary process that leverages digital capabilities and technologies to enable business models, operational processes and customer experiences to create value”

4 Towards a More Comprehensive Understanding of Digital Transformation

This section discusses the concepts used in our proposed definition and further describes the meaning of each concept. Table 6 gives a simple definition of each of these concepts and subsequently, a justification is provided of why each concept was selected for inclusion in the definition.

Table 6: Keywords from the New Definition

Keyword	Simple Definition
Evolutionary Process	A gradual and ongoing series of activities that brings radical change over a period of time
Digital Capabilities	technology skills possessed or required by employees, customers and other stakeholders in different areas that can enable the organization to thrive in a digital environment
Digital Technologies	new and emerging technologies
business models, operational processes and customer experiences	Different areas of the organization which are bound to transform due to the digital transformation process
Value Creation	Organization wide effects and benefits realized as a result of the digital transformation effort, realized by both the organization and the customer

Defining Characteristic(s) of Digital Transformation: Evolutionary Process indicates that digital transformation phenomena is a continuous process, over a period of time (Schuchmann & Seufert 2015, Loebbeck & Picot 2015, Janowski 2015, Wang et.al. 2016, Liu et.al. 2011, Bharosa et.al. 2013). While digital transformation was referred to as a radical change more than as an evolutionary process, we believe an evolutionary process is a more inclusive term that captures the fact that digital transformation evolves with time, and whenever this evolution takes place, the impacts bring about a radical change to the organization. Also, digital technologies as key drivers of digital transformation are in their nature evolving. While earlier forms of digital transformation entailed the introduction of computer based systems and automation of processes, present day digital transformation is more concerned with adoption and use of emerging technologies, which are in their nature evolving.

Drivers of Digital Transformation: Digital Capabilities specifies that in order to thrive in a digital transformation journey, organizations require particular skill set, mind-set and culture that is digital. We argue that relevant skill set and culture - digital capabilities, should be incorporated with digital technologies to achieve the best digital transformation results (Matt et.al. 2015, Schuchmann & Seufert 2015, Tamm et.al. 2015, Berman & Marshall 2014, Loebbeck & Picot 2015). The second key driver identified in our definition, Digital Technologies, indicates that at the foundation of all digital transformation efforts are digital technologies. For technology enabled organizational transformation to take place, technology based systems are at the core of the effort (Besson & Rowe 2012, Cha & Lee 2013). Digital technologies create opportunities that organizations leverage. These opportunities have the potential to transform certain aspects of the organization, especially business models, operational processes and customer experiences. As a result, the organization benefits from impacts of this transformation.

Impacts of Digital Transformation: Value Creation is identified as the key impact brought about by digital transformation. This value is realized by both the organization and its

customers. Value realised include many factors, but not limited to: operational efficiencies, improved customer experiences; enhanced business models; strategic differentiation, competitive advantage, improved stakeholder relationships, cost savings, etc. (Berman & Marshall 2014, Loebbeck & Picot 2015, Luna-Reyes & Gil-Garcia 2014, Janowski 2015, Bharosa et.al. 2013, Wang et.al. 2016, Agarwal et.al. 2010).

Key Transformed Areas of Digital Transformation: Business Models, Operational Processes & Customer Experiences are acknowledged as the key transformed areas of digital transformation initiatives (Westerman, G. et. al. 2011). Focusing transformation on these 3 key areas naturally engages transformation in other aspects of the organization, thus, enabling the transformation impacts to be felt across the organization. For example, transforming operational processes within the organization has the potential to create an impact in other aspects of the organization, such as improving efficiency, costs saving for both the organization and the customer, resulting in value creation.

5 Conclusion

This study has highlighted the lack of a unified and overarching definition of digital transformation as well as inconsistencies in the existing literature. In order to address this gap, a systematic literature review was carried out in order to conceptualize this phenomenon. A concept centric matrix was used to describe the phenomenon in terms of what it is, its characteristics, its drivers, impacts and the transformed areas. Inconsistencies in the definition are also identified and a new and more inclusive definition of digital transformation is constructed and explained.

Other gaps that have been identified during the literature review process include insufficient literature on transformational effects of digital technologies on different aspects of the firm and as well as specific to industries. While digital transformation involves the use of digital capabilities and technologies to impact different aspects of the organization in order to create value, it is also important to understand specifically how different types of digital technologies, paired with capabilities, impact particular aspects of the organization. Moreover, it is important to understand the nature of the value that is created through this transformation. Such research would have significant impact on both theory and practice.

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The Appraisal of Facebook Online Community: An Exposition of Mobile Commerce in Social Media Reviews

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Abstract Social Commerce is a growing upshot of electronic commerce in Nigeria. It is influencing the existing value networks and turning around the global economy. Many authors have impacted the body of knowledge in the context of mobile commerce and social media as a separate research domain, but the fusion of mobile commerce and social media still need more scholars' attention most especially in the developing nations. This study applies the hybrid technique to sort out social commerce customers' reviews, appraise the quality of the extracted data and identify the opinion that transpired between online retailing merchants and online customers. The appraisal theory used for the pairing of mobile commerce and social media explain how attitude and graduation connect engagement in mobile commerce products and services review. The equilibrium of mobile commerce and Facebook stands to improve customer service. This study offers some managerial implications to the social commerce and electronic marketing practitioners.

Keywords: • Facebook • Social Media • Sentiment • Mobile Commerce • Review • Appraisal •

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1 Introduction

In Nigeria, studies have shown social media's influence in different sectors such as education (Ezeani and Igwesi, 2012; Asemah, Okpanachi, Edegoh, 2013), health promotion (Carter, 2014), security issues (Chiluwa and Adegoke, 2013), political participation (Ifukor, 2010; Nnanyelugo and Nwafor, 2013). Fink, Kopecky, Bos and Thomas, (2012) described how certain aspects of an online population can be characterized. However, there is a paucity of research in the context of social commerce which is the focus of this study. Nigeria has a potential for social media and mobile commerce as the Facebook users in Nigeria increased to 16,000,000 (Internet World Stats, 2017) which account for 8.4% of its population. This datum makes Nigeria one of the leading Facebook users in Africa. Also, Nigeria is advancing in mobile commerce, and its ultra-connected population is impacting the revenue of the mobile commerce merchants. Averagely, Nigerians are online once every hour and 20% use the internet at least ten times a day (Nwokpoku, 2015).

Mobile commerce is growing with innovative add-on feature that is influencing the existing value networks and turning around the global economy (Pousttchi, Tilson, Lyytinen and Hufenbach 2015). One of the leading appurtenances of mobile commerce is social media. The union of mobile commerce and social media is multifarious and involves different actors such as online retailers, customers, service and content providers and regulators across various business sectors (Wang, Yuan, Ture and Tu 2015). Mobile commerce entails mobile devices, social media and mobile applications (Pelet and Papadopoulou 2015). Kaplan and Haenlein (2010) classified social media into six groups such as social networking sites (Facebook), virtual social worlds (second life), blogs, collaborative projects (Wikipedia), content communities (YouTube) and virtual game worlds (World of Warcraft).

In 2009, the estimation of Facebook active users reached 175 million (Kaplan and Haenlein 2010) but according to the Facebook active users real-time counts on the internet in February 2017 the user's number has soared to 1.8 billion. In the space of eight years between 2009 and 2017, there was an increase of 1.6 billion Facebook active users. This is more than the population of many countries in the world, for example, China, whose population is now 1.3 billion. This implies justifications of fusing mobile commerce with social media because of its capability to hold a large online community. The sudden surge of Facebook active users is an interesting insight for mobile commerce vendors to capitalize on for customer's engagement, sales conversation and profit making.

Some authors have impacted the body of knowledge in the context of mobile commerce in Nigeria (Inegbedion, Obadiaru, and Bello 2016, George, Ogunkoya, Lasisi and Elumah (2015) and social media as a separate research domain (Chiluwa and Adegoke 2013, Carter, 2014) but the fusion of mobile commerce and social media needs more study especially in the developing nations. Pournarakis, Sotiropoulos and Giaglis (2017)

discovered a gap in social media data collection and analysis and came up with a computational model that combined the strength of topic and sentiment classification to draw out consumer perception on important subjects in social media. On the other hand, Kaplan and Haenlein (2010) endeavoured to clarify the notion about the real meaning of social media in comparison with close concepts like Web 2.0 and User Generated Content and apprise the companies that wish to adopt social media with the major points of advice. Despite the contribution of recent studies (Pelet and Papadopoulou 2015; Makki and Chang 2015; Hew et al. 2016; Tan et al. 2016), there is still need for more academic impact in the research stream of social commerce.

The different researches that focused on the topics relating to the union of mobile commerce and social media are rare and statistical reputation in the developing country such as Nigeria actuate further study of mobile social commerce. Studies have fused social media and mobile commerce (Pelet and Papadopoulou, 2015, Tan, Teo, Tan and Yang, 2016). This study seeks to use hybrid approach that combines different methodology and data analysis techniques. We used netnography, a form of online participant-observational technique (Kozinets, 2010). The study also employed sentiment analysis for mobile commerce Facebook followers' opinions, sentiments, evaluations, appraisals, attitudes, and emotions towards entities such as products and services (Bing, 2012). This paper is guided by a general objective to analyse the interwovenness of mobile commerce and social media with these specific objectives: (1) to state the importance of social media in online shopping, (2) to analyse online Facebook reviews, sentiment and examine customer service (3) to develop an explanatory theory that associates mobile commerce with social media.

2 Theoretical Framework

Appraisal theory claims that people evaluate the personal meaning of an exciting event or events before emotional responses are generated (Cherng and Timmy, 2015). The appraisal theory of emotion has been used to examine the relationships between appraisals, consumption emotions and post-consumption behaviors (Bougie et al., 2003; Nyer, 1997; Soscia, 2007). The form and emergence of emotions depend on cognitive appraisal process which are their byproducts (Bagozzi et al., 1999; Lazarus and Lazarus, 1994).

Bloom (2011), said the theory of appraisal shift sentiments classification further and considers the assessment expression as a basic grammatical unit by which an opinion is expressed. Opinion are classified in previous studies mainly to their polarity as positive, negative or neutral besides which appraisal expressions covers additional attributes of opinions that extend the core description of the expressed opinion (Šimko and Korenek, 2014). The basic attributes attitude, which are engagement and graduation are complementary with polarity/orientation (Martin and White, 2005).

The identified attributes of appraisal theory are:

Attitude – Attitude is the essence of emotion the appraiser conveys about the product or services. It is about a talk on how it affects the appraiser’s feeling such as anger, fear, jealousy, excitement, hostility, satisfaction or appreciation. Emotions or attitudes that can be expressed in appraisal groups, such as: “It’s such a wonderful day!”. In more formal contexts such as news articles, expressions such as “This policy will not work” are considered appraisal groups conveying attitude.

Graduation – Graduation refers to the strength or force of emotion and attitude in each appraisal group. Adverbs such as “fairly” or “soulfully” indicate graduation. Words used to express attitude can also contain an indication of graduation, for example, “dislike” versus “detest”.

Engagement – Sentiment can be expressed directly or indirectly, or attributed to another source. Engagement is the way speakers or writers express appraisal or engage in the argument. The engagement is monoglossic if the speaker/writer has directly expressed the appraisal, e.g. “The President has no idea what he is talking about”. It is heteroglossic if the speaker/writer has either attributed to another source or has tried to use other methods to prove the point or make it more credible, for example, “Data from previous studies show there is little hope that his strategy will work” (Christopher, Khoo and Jin-Cheon, 2012).

Orientation – It recognizes if a term is positive or negative. Some studies refer to this attribute as polarity (Pandey and Iver 2009). In contrast, the polarity attribute represents the fact that a sentimental term can be unmarked or marked. That means that the term “orientation” can be influenced by an expression that negates the meaning of the phrase or a sentence. If a term contains such a negation (not, never), it is labelled as marked. According to Šimko and Korenek (2014), the main advantage of using the appraisal theory in sentiment classification is that it helps to take a look deeper inside the mind of authors who wrote texts and find out their real meaning using linguistic and psychological analysis of their texts.

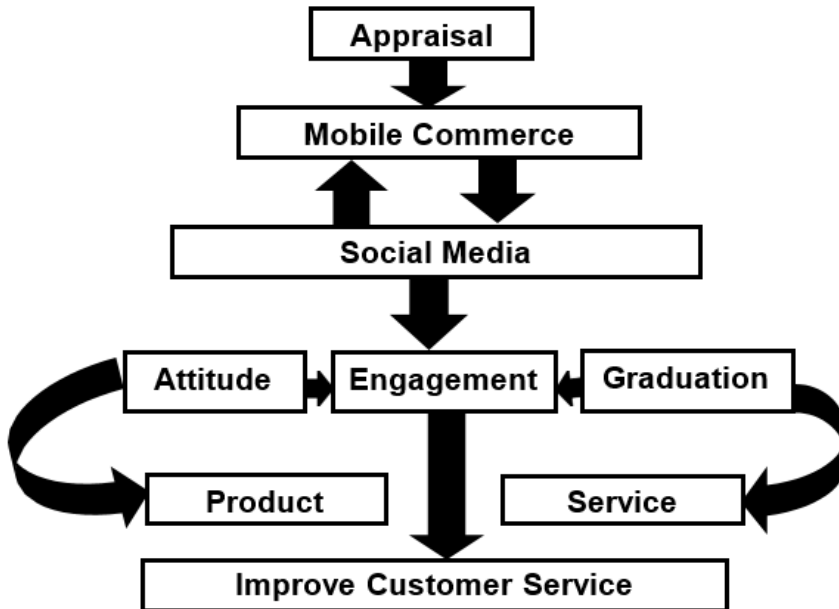


Figure 1: Social Commerce Model

3 Methodology

The growth of technology most especially in the area of social media is aiding the researchers to adopt different research methodology. This paper seeks to use a hybrid approach that combines different methodology and data analysis techniques such as entity and aspect-level sentiment, manual techniques, data mining, text mining and netnography to overcome some of the problems that existing researchers had identified concerning sentiment analysis of social media in their studies. Some of the authors have identified the problem of using slangs, disjointed words, incomplete phrase or sentence and buzz words that lack proper understanding and meaning. Kozinets (2010, p.1) defined netnography as “a form of ethnographic research, adopting the participant-observational approach and taking online interactions as its fieldwork”. Netnography preponderates tourism research stream (Wu and Pearce 2014), but Kozinets (2015) recommends Netnography methodology to researchers that work with social media and other online platforms.

The study followed five-stage outlines mapped out by Kozinets (2010) to extract data from electronic commerce Facebook online community as a participant-observer. We planned the data collection, the extraction and the coding to get insight from the data. One of the authors represented himself on the e-commerce Facebook online community as an observer, and we extracted the data with NCapture, a browser plug-in that allows us to capture the data of e-commerce product and service reviewers. We opted for

NCapture among others because of its file transfer compatibility with NVivo 11 Plus that we adopted for data coding. For this study, we used NVivo 11 Plus for e-commerce merchants' classifications and aspect-level sentiment analysis with observance of relevant ethical issues.

We also used NVivo 11 Plus for data, text mining and complement it with LikeAlyzer, an online Facebook analysis tool to calculate the Facebook online community engagement rate based on the following formula: $p/l = E$. P: represent People Talk About This (PTAT – Facebook Followers), L: depicts Likes (Facebook Fans) while E: equals Engagement Rate (Tables 1, 2 and 3 illustrate the engagement rate of 10 General Ecommerce Merchant Retailers, 15 Specialty Retailers and 8 Agency Retailers respectively).

4 Sentiment Data Analysis

The emergence of the social media has turned things around in mobile commerce. In social media, retailers can only measure their Return on Investment (ROI) through advertisement in form of sales but to appraise the sold-out products and services rendered to the customers, is a bit challenging. Through online reviews and posts on social media like Facebook, it is easy for online community members to learn from one another, state their experience, express their opinion and synchronise cultures. We adopted five steps process posited for sentiment analysis from the work of Nikumbh, Nikumbh and Gaikwad, (2016). We skipped data collection and text preparation postulated by Nikumbh et al. (2016) because we had earlier used Netnography approach but we used NVivo with manual techniques for sentiment detection, sentiment classification and output presentation. We exported data extracted with NCapture to the NVivo which consists 15,790 General Merchants Retailers reviews, 1,559 Specialty Retailers reviews and only 256 Agency Retailers reviews. All together for 33 electronic merchants in Nigeria, we had 17,605 Facebook reviews. We used the word query to analyse the most frequent one thousand words. The result gave us a clue to the keywords that are necessary for coding to discover emerging themes from the data. We also performed word frequency clustering analysis for the General Merchant Retailers, Specialty Retailers and Agency Retailers (See figure 2 for thematic analysis in details).

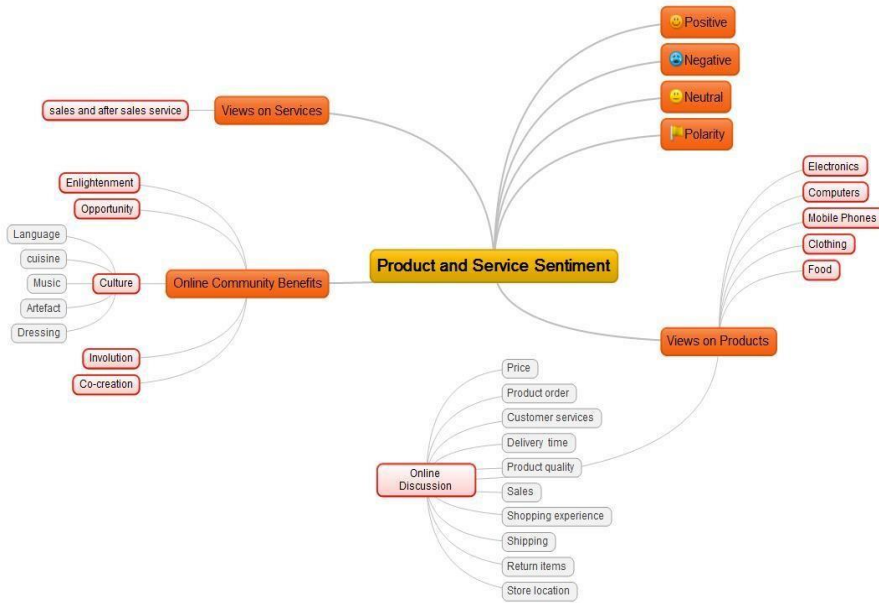


Figure 2: NVivo 11 Plus Thematic Analysis

We performed Jaccard similarity coefficient analysis between positive and negative review of Facebook online community reviews for e-commerce products and services. We performed Jaccard statistic test with NVivo 11 Plus to compare the similarity and diversity of positive and negative online community sample. If the sets data result would be 100% similar, it means the closer to 100% signify the intensity of the similarity, and in comparison, 80% will be more similar than 70%. NVivo generates Jaccard's coefficient result of 0.038961 based on 7235 positive and 1783 negative references. We multiplied the result by 100, and it gives us 4%. The word similarity of positive and negative reviews is 4%. To get the dissimilarity of the positive and negative review, we subtract the Jaccard index from 100% ($100 - 4 = 96\%$). The Jaccard distance between the positive and negative reviews is 96%.

4.1 Facebook Online Community Engagement Rate

The tables below show the mobile commerce engagement rate on Facebook online community in Nigeria.

Table 1: General Merchant Retailer

No.	Page (Status)	Likes	PTAT	ER	Like Rank
1.	Shoprite	1,192,581	10,191	0.85%	77
2.	Konga	1,521,848	3,538	0.23%	64
3.	Jumia	6,841,120	31,743	0.46%	74
4.	Yudala	16,975	360	2.12%	61
5.	Katadeals	840	675	80.36%	82
6.	Gloo	27,199	12	0.04%	59
7.	Payporte	262,786	33,823	12.87%	86
8.	Spar	38,078	755	1.98%	53

Table 2: Specialty Retailer

No.	Page (Status)	Likes	PTAT	ER	Like Rank
1.	Atunnise	496	1	0.2%	15
2.	Ajebomarket	68,206	209	0.31%	50
3.	Ohmashoes	7,336	888	12.1%	77
4.	Coliseum	70,053	176	0.25%	39
5.	Fashpa	54,510	22	0.04%	38
6.	Fastforward	2,427	0	0%	21
7.	Jumia Foods	308,024	762	0.25%	53
8.	Easyappelite	2,403	2	0.08%	12
9.	Mamtus	2,324	5	0.3%	49
10.	PCPlant	37,188	96	0.26%	50
11.	Slot	284,408	488	0.17%	56
12.	Teeday	1,778	2	0.11%	17
13.	Shopaholic	9,513	6	0.06%	27
14.	Buyright	55,482	29	0.05%	35
15.	Shopkudi	13,013	5	0.04%	39

Table 3: Retail Agency

No.	Page (Status)	Likes	PTAT	ER	Like Rank
1.	Mystore	56,629	6	0.01%	25
2.	PEP	62,445	1,337	2.14%	39
3.	Mannastores	23,738	6	0.03%	49
4.	MallforAfrica	189,580	4,120	2.17%	73
5.	LoyalBonus	5,650	21	0.37%	42
6.	Jiji	676,478	120,228	17.77%	80
7.	Dealdey	177,518	268	0.15%	46
8.	Domesticco	11,287	890	7.89%	79

As shown in the tables 1, 2 and 3 above, the Engagement Rate is calculated by taking the total PTAT (people talking about this) and divide by the total number of 'likes'. Surveys show that to have success on Facebook, an engagement rate greater than 7% should be met as revealed by Facebook LikeAlyzer tool. In the GMR categorization, it shows that only two of the mobile commerce successfully engaged their customers with 80.36% and 12.87% respectively. All the specialty retailers sampled shows very low engagement with their clients while two of the retail agencies sampled indicated that they recorded success in engaging their customers at 17.77% and 7.89%. This result reveals that generally, most of the Merchants and Vendors do not actually engage their customers. It is very important to note that it is not sufficient to have many 'likes' but to have many 'PTAT' as well. Many 'likes' and low 'PTAT' yields a very low engagement rate as seen for example in Shoprite, Jumia and Konga. Recording a high or low 'PTAT' and a corresponding number of 'likes' will yield a very high engagement rate as evidenced in Katadeals, Payporte and Jiji. It is not enough to have millions of 'likes' on the Facebook platforms of mobile commerce while 'PTAT' is very low as it is crucial for a successful engagement rate with customers.

Our results, based on sentiments detection from the reviews on the e-commerce merchant social media platform (Facebook) are classified under four headings. These are: views on Products and Services, Online Discussion, Merchant's Response and Online Community Benefits. These classifications identified the attributes of appraisal which include attitude, graduation, engagement and polarity. All these constructs are interlinking in the expressed opinions of consumers on products or services.

4.2 Product and Service Sentiment

The analysis starts by investigating polarity, which is useful for determining the overall sentiment orientation or bias of a document or person towards an object or services. Consumers shared their views on products such as electronics, computers, mobile phones, clothing and food items. We extracted the reviews of product and services from the Facebook page of mobile commerce platforms. The excerpts below depict the mind of the reviewers:

Positive: I love GMR (FS, Male, Lagos, January 16, 2017)
I like RA stores (UAO, Female, Owerri, January 26, 2017)

Negative: GMR is selling products that are of low standard, inferior and low quality because I bought a 32-inch Sharp TV and after two weeks the TV couldn't power on. (FP, Male, Lagos, January 4, 2017).

Neutral: I have never had any issues with GMR... (AA, Male, Lagos, January 4, 2017).
People have been talking about GMR but I never patronize them (IBF, Male, Abeokuta, November 24, 2016).

Polarity: The delivery is awesome but, 800 naira is too much within Lagos, I ordered for 6 different items, and they charge me 800 naira for each, which is very bad (AS, Male, Lagos, November 20, 2016).

I enjoyed the Lenovo tab I bought from them just that it doesn't have flash so painful (BIR, Female, Ilorin, November 15, 2015).

The above quotes from the online shoppers depict their experience and show their positive, negative, neutral and polarity comments on products and services rendered to them by the General Merchant Retailers and Retail Agency.

4.3 Online Discussion

The most discussed topic that generated contributions from consumers on the e-commerce platforms as identified are price, product order, customer services, delivery time, product quality, shopping experience, shipping, return items, store location. This is evidenced in figure 2 above. The excerpts below express the mind of the reviewers:

Price: how can your price of shipping be more than the goods or items being Bought...If you keep going like this, it will get to a stage where no one will buy anything from GMR (NI, Female, Kano, September 8, 2016).

Product Order: Very poor. You place an order and never get a response.

If a large company like Amazon with millions of daily orders can easily manage them, why can't... (BA, Male, Lagos, January 9, 2016).

Customer Services: The attitude of your rep AO is appalling. He is rude, arrogant and treat customers call with disdain. Please I need my order-xxxxxxx delivered tomorrow unfailingly (AMA, Male, Lagos, December 6, 2016).

Delivery Time: Customer care was wonderful. GMR especially could work on their delivery time too (JD, Male, Port Harcourt, July 15, 2016).

Product Quality: ...GMR selling products that are of low standard, inferior and low in quality. (FP, Male, Lagos, January 4, 2017).

Shopping Experience: ...I have a very terrible experience with SR in Abuja. If they offer you warranty or screen insurance, beware and run for your pocket (OO, Male, Abuja, November 1, 2016),

Shipping: GMR started well. I lost confidence in their products after they shipped me fake LG microwave and Havell toaster...(SN, Male, Nasarawa, November 13, 2015).

Return Items: I bought two short from RA for my baby at their store in Akure but was too small for him. Please can I return it for exchange (OAI, Female, Ekiti, December 27, 2015).

Store Location: I haven't Patronize RA so I don't know what to say about them (JM, Female, Lagos, May 12, 2016).

The expression as seen in price shows the engagement aspect of appraisal with the statement being attributed to another source which shows heteroglossic engagement. In product order, the statement "very poor" shows negative polarity as the next sentence is attitudinal, and further statement expressed heteroglossic engagement. Consumer service review depicts attitude as well as negative like product quality review. For delivery time, the reviewer express graduation with the word "wonderful" used and the review for shopping experience shows negativity and heteroglossic engagement aspect of appraisal. Under shipping, the statement is categorized as polarity reviews made under the return items, and store location is neutral.

4.4 Online Community Benefits

The authors deduced certain advantages for the mobile shoppers as evidenced from their Facebook page reviews under the headings of enlightenment, opportunity, involution and co-creation.

Enlightenment: How To Make A Teddy Bear Out Of A Towel (RA, January 30, 2017). Lovely. I will try to make one for my grandchildren. Practice makes perfect (CO, Female, Lagos, January 31, 2017).

Opportunity: Business opportunity!

We are currently Leading an Expansion of a global fuel company and we are competing against the Trillions in Revenue ... (OD, Male, Lagos, May 29, 2014).

Involution: DO NOT SHOP ON GMR!! Product Quality always totally different from description their coupon doesn't work either they still charge the same amount even after using the coupon...crap!! Don't do it please! (AA, Male, Lagos, January 4, 2017).

Culture: This include language, cuisine, music, artefact and dressing. The cultural display shows the interplay of various culture represented on the platform due to ethnic diversity of Nigerian states.

Co-creation: To maximize customers experience, SR should incorporate a 'trade-in' program. I have a good idea on how this can double the current turnover of SR business. Reach me via 080XXXXXXXXX or xxxx@aol.com in case the business is interested in this idea (IA, Male, Iwo, July 13, 2014).

Enlightenment as a benefit brings about passing knowledge about something to others. This is shown in the statements made by the reviewers under enlightenment, teaching others how to do new things. Customers advertises, exchange ideas and present business opportunities for other customers alike.

4.5 Merchant's Response

The merchant response is very important for whatever brand to communicate, engage the customers or consumers and redeem the image or solve issues relating to patronage and many more. Some of the excerpts below are from merchant responses to comments on their products and services.

So sorry for this experience. Sadly, the item delivered is the item ordered. Since the seal has been broken, we'll be unable to retrieve the item. An agent has been assigned to contact you regarding this. Thank you (GMR Representative, December 21, 2016).

We're delighted to receive your feedback and are super glad that you enjoyed our service. (GMR Representative, December 30, 2016).

Thank you for your kind words VO, quite appreciated. Please spread the word... And we welcome referrals... (SR Representative, April 2, 2015).

The first response given above represent the attitude and the information passed as evident in the merchant comment reveals that the terms and condition of the agency is not known by the consumers as alluded to in the comment. The other responses received encouraging feedbacks about their product and services and they appreciated them. Going by the reviews generally, the rate of reply of the merchant to the reviewers is slow as there are complaints about response rate. It seems there is no personnel designated to answer the queries of customers.

5 Conclusion and Implication

Despite the prevalence of e-commerce, mobile commerce and social media as an interwoven study in diver disciplines (Huang and Benyoucef 2015), it is noted that few scholars in the field of electronic marketing have fully explored the connectedness of mobile commerce and social media for customers' service improvement. This study applies the hybrid technique to sort out social commerce customers' reviews, appraise the quality of the extracted data and identify the opinion that transpired between online retailing merchants and online customers. The unicity of this study lies in the accessibility of large dataset of online multiculturalism douse with emotion. Although this study is an overture of social commerce in the context of developing countries such as Nigeria, we are able to gain insight into the sentiment of online shopping. Due to this development, it is viewed that this study will set a pace for online shopping customer engagement through social media in electronic marketing. It makes this study one of the foremost in

Nigeria. Our study contributes to the literature of electronic marketing in several ways. This study demonstrated the importance of social media in e-commerce in a new way by identifying the benefits of online community reviews and exhibited reviewers' emotions. Though our findings were based on Facebook data generated from 2014 to 2017, the result reflects how online shopping experiences ensued emotion in Facebook Commerce reviews. The study reveals the intensity of positive, negative, neutral and polarity sentiments. This study furthermore emphasized the explanatory power of theory for the union of mobile commerce and social media. The appraisal theory used for the pairing of mobile commerce and social media explain how attitude and graduation connect engagement in the context of products and services review. The equilibrium of mobile commerce and Facebook social media stands to improve customer service.

Some managerial implications were offered as it advocates the significance of social media in mobile commerce to the electronic marketing practitioners due to its vastness. Many online consumers have turned Facebook into their second home, and it will be easy for the mobile commerce merchants to reach them for feedback in real-time. The study also emphasizes the importance of Facebook followers and clarify the differences between the Facebook 'likes' and 'PTAT' as the determinant of customer's online engagement. The engagement rate is one of the useful metrics for Merchants that uses Facebook online reviews. This study is not without limitations, and its explanation should be treaded carefully. It is a common argument that social media data validity is not a clean-cut (He et al. 2014, Panger 2016) but (Rife et al. 2016) recommends heterogeneous Facebook users and generalized result as a standard for online data validity. Rife et al. (2016), testify to the viability of Facebook data over traditional samples. Demographic data is hard to extract, but we limit the quotes to the reviewers that make their name, sex, domicile available on their Facebook page. There were more positive reviews (80%) than the negative (20%), the neutral and polarity were scanty. Another limitation was that the sample represents general merchants retailing, specialty retailing and agency retailing and only 33 of the mobile commerce retailers were available for this study. According to Fink et al. (2012), social media is a viable means of getting enriching social and cultural data for studying the developing nations. Future studies should endeavour to examine online reviews of social media such as Twitter, Instagram, Google+ and Pinterest regarding mobile commerce as a comparative study.

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Coupons from Deal Sites as Gifts: Impact of Gender, of Age, and of Personality Traits

ANTONIN PAVLICEK & FRANTISEK SUDZINA

Abstract There already exist studies on what influences use of deal sites. But there is a gap in literature when it comes to purchasing coupons from deal sites and then using them as gifts. The paper analyzes whether gender, age and personality traits influence such behavior. Big Five Inventory traits and narcissism were used. The impact of age was significant. Significance of agreeableness and of narcissism were somewhat above cutoff value 0.05, therefore borderline significant. All of them have positive effect.

Keywords: • Deal Sites • Gifts • Personality Traits • Empirical Research •

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1 Introduction

Deal sites, also referred to as Group Buying Websites, are a well established trend in on-line commerce to get a better price by volume discount. Original idea behind a deal site is to group consumers together forcing the merchants to offer wholesale prices to these groups. Merchants sell products and services at significantly reduced prices, usually 40% off or more, on the condition that a minimum number of buyers would make the purchase. When the minimum number of orders is reached, the deal becomes activated and all the customers that signed up for the deal become eligible to purchase. If the minimum number of orders is not reached within agreed time period, usually 1 - 7 days, then the deal is cancelled.

Group buying promotions can generate a large number of sales in a short period of time thanks to the viral nature of this promotion, often promoted on social networking sites. Merchant's sales can be boosted by the order of hundreds to thousands of orders in a single day/week.

Because deal sites take up to 40 % of the price, the merchant is only making slight margin, sometimes even sustaining short-term loss for the following reasons (Drossos et al., 2015):

Cash flow boost

Payments for vouchers are processed within short period after the deal is closed so the merchant receives a quick boost in cash flow.

Effective advertising

Daily deals promoted by group buying websites are fairly inexpensive and they are much more effective at generating real sales rather than just increasing brand awareness.

New customers

Deal sites are able to attract new clients by offering large discounts that get the first-time customer in the door, although retention of such price sensitive clients can be problem. Groupon is possibly the most well-known deal site. From a business model perspective, it can be classified as affinity club (Johnson, 2010), round-up buyers (like Linder and Cantrell's (2000) buying club), and trade show (like Timmers' (1998) third-party marketplace) in the framework compiled by Taran et al. (2016). In spite of Groupon being the so well-known, group-buying is not the main, nor the mandatory feature of deal sites.

1.1 Deal sites in the Czech Republic

Deal sites have been present in the Czech Republic since 2009. They gained general popularity in 2010 with the advent of the company Slevomat.cz, the leader of the Czech market, whose name became synonym with group shopping in the Czech Republic. By 2015, the Czech market was reaching an annual growth of 50%, however in the past two years, the market has achieved its growth limits, global market turnover has stabilized and there has been dramatic reduction of the number of firms. In the market, there currently operates 45 active deal sites, top 5 of which control 90% of the market share, leader (slevomat.cz) dominates with 40 %. In August 2011, when the number of companies reached was the highest, there were 204 registered servers (4 times more than today). Czech market cleared and since 2015, there has been a period of consolidation in positions and brands.

Slevomat.cz - in 2015 had a turnover of more than CZK 1.2 billion, which is almost a billion more than the rest; deal sites Pepa.cz, Vykupto.cz, Nakupvakci.cz, Hyperslevy.cz have revenues ranging up to around CZK 300 million. Additional figures are provided in Table 1.

Table 1: Top Czech deal sites, data from companies' annual reports

	Revenue 2012 (mil CZK)	Revenue 2015 (mil CZK)	Employees 2017	Page visits daily 2017
Slevomat.cz	758	1.200	160	200.000
Vykupto.cz	320	300	35	33.000
Zapakatel.cz	260		Bankruptcy 6/2014	
Hyperslevy.cz	159	300	40	30.000
Pepa.cz	138	300	43	66.000
Nakupvakci.cz	102		Bankruptcy 12/2016	
Slevoteka.cz	60	105	10	130.000

During the consolidation of the market, there were couple of merges of smaller companies, as well as bankruptcies of a relatively large players (Kouzelnýdeda.cz, Zapakatel.cz, Nakupvakci.cz).

Discount coupons are still the fourth most common product sold on the Czech e-commerce, the most popular commodities are: Food, Fashion, Things to Do, Health and Fitness (Weight Loss), Travel, Skin Care, Massage, Beauty, Wellness, Education (language courses).

Slevomat.cz is the clear leader among Czech deal sites. It offers the widest range of experiential services such as adrenalin and cultural events, gastronomy and weekend stays. Slevomat stopped selling fashion goods, they focus on services with higher value, especially with the advent of shopping via mobile phone. The portal also provides assurance (in the event of a problem customer gets the money back) to its customers, since in the competitive market, it is crucial to guarantee satisfaction.

1.2 Literature review

To the best of authors' knowledge impact of personality traits on gift giving specifically linked to deal sites has not been investigated yet. The literature search has brought only couple of journal articles and a few conference papers investigating gift giving in general.

Personality trait can be defined as habitual patterns of behavior, thought, and emotion (Kassin, 2003). Traits are relatively stable over time, differ across individuals (e.g. some people are shy, whereas others outgoing), and influence behavior. Traits are in contrast to states which are more transitory dispositions. Agreeableness is a personality trait manifesting itself mainly in such behavioral characteristics that are generally perceived as kind, cooperative, sympathetic, warm and/or considerate. Narcissism could be defined as the pursuit of gratification from vanity or egotistic admiration.

There is a published study of relational signaling over recipient preferences in their gift choices (Ward and Broniarczyk, 2016), which point out, that givers balance their goal to please recipients with gifts that match recipient references against their own goal to signal relational closeness with gifts that demonstrate their knowledge of the recipient. Close givers' divergence from the gift-registry is not the result of their altruistic search for a "better" gift but is a strategic effort to express relational signals: it occurs only when givers will receive attribution for their choice.

Same authors in 2013 also point out, that gift giving creates giver identity threat as a function of social closeness (Ward and Broniarczyk, 2013). They established, that gift giving, in which individuals may make product choices that run counter to their own identities in order to fulfil the desires of the intended recipient. Purchasing an identity-contrary gift for a close (vs. distant) friend who is an integral part of the self can itself cause an identity threat to the giver, who subsequently engage in behaviors that reestablish his identity such as indicating greater identity affiliation with the threatened identity and greater likelihood to purchase identity-expressive products.

The role of narcissism, self-esteem and gift giving was discussed by (Hyun et al., 2016) in their exploratory study that identifies romantic gift-giving motivations and examined these motivations in relations to the two personality constructs. A factor analysis found three motivations for romantic gift giving: intrinsic, maintenance, and power motivation. When self-esteem, age, and sex were controlled, narcissism was positively related to maintenance motivation in the past, and maintenance and power motivation in the future.

Self-esteem was negatively related to power motivation in the past and maintenance motivation in the future, controlling for narcissism, age, and sex.

An exploration of influences on attitudes to giving and receiving gifts (Perryer and Tsahuridu, 2013) reports the results of a study that examined the influence of organisational level and education on attitudes towards giving and receiving gifts in exchange for preferential treatment in three cultural groups. Analysis of the data using hierarchical regression revealed that after controlling for age, gender, cultural background, business sector and years of service, respondents' organizational level and education positively influence attitudes to accepting gifts, while only education influences attitudes to giving gifts.

Contributions to gift-giving theory from an identity-stripping context (Klein et al., 2015) measured by the Identity-Based Motivation (IBM) model to examine gift giving within the identity-stripping context of Nazi concentration camps, as reported in the memoirs of Holocaust survivors is a bit extreme example of gift-giving oriented scientific paper. By exploring gift giving in this crisis-laden context, authors demonstrate the fundamental role gifts can play in re-establishing personal and social identities and provide insights into the motivations for giving that go beyond the existing paradigms that emphasize social exchange, economic exchange, or agapic giving.

The role of adolescents' gift giving in managing their impressions among their peers (Segev et al., 2012) examines adolescents' gift giving using a qualitative methodology, based on impression management theory. Gift-giving motives and the characteristics of the chosen gifts indicated that adolescents use gift giving instrumentally to manage and protect their impressions among their peers. The research provides evidence regarding different types of gifts such as joint, neutral, and twofold gifts.

While research on self-gift consumer behavior has shown evidence of the importance of this behavior in Western cultures, there is no understanding of self-gift giving in collectivist cultures. Tynan et al. (2010). used personal interviews to establish the existence of self-gifting in China, and further to compare motivations for and the emotions associated with it. Their findings indicate that self-gifting is less self-oriented for the Chinese than for the British.

Gittell and Tebaldi (2006) found that charitable giving by households in the United States is significant. They estimate, that private giving represents more than 2 % of total gross domestic product and is a significant factor in funding the nonprofit sector. Their research adds detailed data and analysis supporting and supplementing research that identifies personal income, capital gains, religious group affiliation, age, volunteerism, and educational attainment as the main factors affecting household giving.

The aim of our paper, based on the identified gap in the literature, is to analyze impact of gender, age, and personality traits on purchasing coupons from deal sites as gifts. The

rest of the paper is organized in the following way: In the next section, there is a description what data were collected and how, and how they were analyzed. In the following section, results of the analysis are presented. The last section offers conclusions.

2 Data and Methodology

The data was collected in December 2016 to January 2017 using an on-line questionnaire. Respondents were 264 university students from the Czech Republic, of which 140 respondents indicated that they use deal sites, and 124 do not. The analysis of use versus non-use of deal sites from this data set was published in (Sudzina and Pavlíček, 2017).

SurveyXact was used for the questionnaire. Unlike Qualtrics, it does not allow to show/hide questions based on answers to questions on the same page. Therefore, the questionnaire was split into two pages and questions for deal sites users appeared on the second page. Seven respondents stopped after the first page and one respondent provided random high numbers as answers for multiple open-ended questions, hence this row was excluded from the analysis. So, the effective sample size is 132 (43 men, 89 women; on average 20 years old).

On the second page of the on-line questionnaire, there was a question regarding the number of coupons purchased on deal sites as gifts. The distribution of the answer is provided in Figure 1. Since the distribution of the number of gifts is right-skewed, ordinal logistic regression is used for the analysis. SPSS software was used for the analysis.

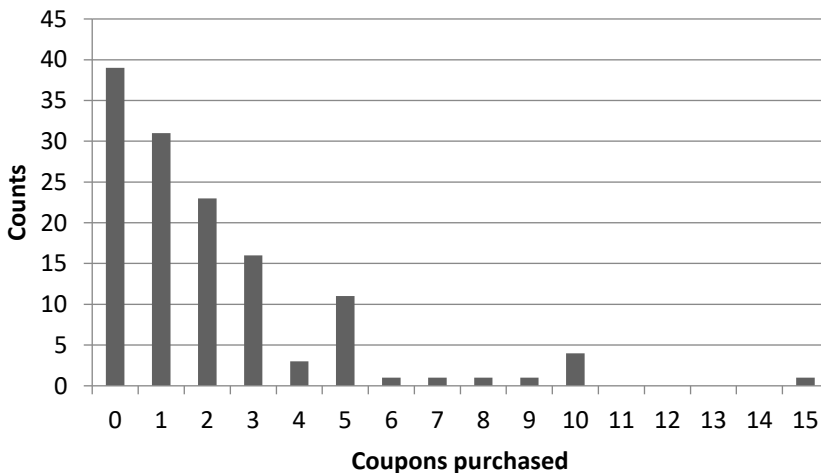


Figure 1: Distribution of the number of coupons purchased on deal sites as gifts

Personality traits were measured using Rammstedt and John's (2007) Big Five Inventory-10, i.e. a shortened 10-item version of the Big Five Inventory questionnaire developed by John and Srivastava (1999), and translated to Czech by Hřebíčková et al. (2016). The instruction was to rate "How well do the following statements describe your personality" with statements "I see myself as someone who..."

- ... is reserved,
- ... is generally trusting,
- ... tends to be lazy,
- ... is relaxed, handles stress well,
- ... has few artistic interests,
- ... is outgoing, sociable,
- ... tends to find fault with others,
- ... does a thorough job,
- ... gets nervous easily,
- ... has an active imagination,

on a 1-5 Likert scale where 1 meant strongly disagree and 5 stood for strongly agree. Extraversion was calculated as an average of the 1st (reversed-scored) and the 6th answer, agreeableness as an average of the 2nd and the 7th (reversed-scored) answer, conscientiousness as an average of the 3rd (reversed-scored) and the 8th answer, neuroticism as an average of the 4th (reversed-scored) and the 9th answer, and openness to experience as an average of the 5th (reversed-scored) and the 10th answer.

The researchers are aware of the new version of Big Five Inventory - Big Five Inventory-2 with 60 items (Soto and John, in press a), and of 30-item short and 15-item extra short versions (Soto and John, in press b) but there is no validated translation available yet.

Narcissism was measured right after Big Five Inventory-10 using the same instruction, with the statement

- ... is of narcissistic nature (note: narcissistic means egotistical, self-focused, vain)

The statement was adapted from The Single Item Narcissism Scale (SINS) developed and validated by Konrath, Meier and Bushman (2014). They recommend SINS for online studies.

The questions related trust issues have been summarized in an article Trust, innovation, prosperity (Szabo et al., 2013).

The questionnaire contained additional questions which were not used in the analysis presented in this paper.

3 Results

The research question is whether gender, age, extraversion, agreeableness, conscientiousness, neuroticism, openness to experience, and narcissism influence how many coupon does a user of deal sites buys as gifts. Since the distribution of the number of gifts is right-skewed, ordinal logistic regression is used for the analysis. Ordinal logistic regression results for the full model are provided in Table 2. Cox and Snell R² is 0.122, Nagelkerke R² is 0.126, McFadden R² is 0.35 and p-value is 0.028.

Table 2: Ordinal logistic regression

	Estimate	Std. Error	Wald	df	Sig.	95% Confidence Interval	
						Lower Bound	Upper Bound
[gift = 0]	4.004	1.841	4.731	1	.030	.396	7.613
[gift = 1]	5.075	1.858	7.459	1	.006	1.433	8.717
[gift = 2]	5.910	1.874	9.946	1	.002	2.237	9.584
[gift = 3]	6.678	1.891	12.476	1	.000	2.973	10.384
[gift = 4]	6.864	1.895	13.118	1	.000	3.149	10.578
[gift = 5]	7.830	1.925	16.542	1	.000	4.057	11.603
[gift = 6]	7.966	1.931	17.024	1	.000	4.182	11.750
[gift = 7]	8.122	1.938	17.570	1	.000	4.324	11.919
[gift = 8]	8.304	1.947	18.197	1	.000	4.489	12.119
[gift = 9]	8.506	1.958	18.872	1	.000	4.668	12.344
[gift = 10]	10.149	2.165	21.971	1	.000	5.906	14.393
Age	.315	.097	10.414	1	.001	.124	.506
Extraversion	-.022	.186	.014	1	.904	-.387	.342
Agreeableness	.414	.231	3.207	1	.073	-.039	.868
Conscientiousness	.181	.203	.799	1	.371	-.216	.579
Neuroticism	.181	.168	1.155	1	.282	-.149	.510
Openness to experience	.095	.187	.261	1	.609	-.271	.461
Narcissism	.333	.171	3.769	1	.052	-.003	.669
[gender=male]	-.299	.386	.601	1	.438	-1.056	.457

The impact of age was significant. Impact of agreeableness and of narcissism were borderline significant. All of them have positive effect – older, agreeable and narcissist people are more likely to use coupons as a gift.

4 Conclusion

Purchasing coupons from deal sites and then using them as gifts is significantly influenced by age (impact of agreeableness and of narcissism is borderline significant).

Age could be mediated through several variables, e.g. somewhat older people lived longer, so they gave gifts for a longer period; somewhat older may have a better income; somewhat older people may have a better overview what is available on deal sites that their friends could enjoy.

In light of the literature mentioned previously, our research is filling the gap in understanding, how the coupons are used in gift-giving mode and which personal traits can be traced to such behavior.

As for implications for marketers, there would be problematic recommendation: either to focus coupon campaigns on older clientele with narcissistic inclinations, or controversy focus on the customers, who are empathetic and altruistic.

Rammstedt and John (2007) mentioned that the two-item measure of agreeableness does not have as good properties as measures of the remaining four of Big Five Inventory traits. Therefore, in the future research, it may be worth to add a third item, namely "...is considerate and kind to almost everyone." It could possibly improve significance of agreeableness.

Now that there is an indication of impact of narcissism on purchasing coupons as gifts, it is justifiable in future research to use more items to measure narcissism, such as Narcissistic Personality Inventory (Raskin and Terry, 1988) which is probably the most widely used measure of the narcissism and contains 40 forced-choice items. If a longer instrument is to be chosen, such as Five-Factor Narcissism Inventory (Glover et al., 2012), which contains 148 items, it may be advisable to select only certain factors.

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Combining Digitization with Healthcare Service Processes: Value Co-creation Opportunities Through Standard Work

KATJA RANTALA & HEIKKI KARJALUOTO

Abstract The study explores some implications of digitized healthcare services for value co-creation opportunities and work standardization and introduces DARIO, a value co-creation model of digitized services. The key development is the model's focus on service processes that emerge through standardized work, providing opportunities for value co-creation. The DARIO model seeks to combine the theory of value co-creation and operations through lean standard work. The digitization of healthcare services is typically discussed from technological, medical science or customer perspectives, but opportunities for professionals to participate or to perform in the value co-creation process are less widely studied. The digitization of healthcare services changes service processes and the professional's work. As professionals may not automatically adopt new digital services and uncertainty surrounds the related work processes and workloads, managerial support is needed in defining standard work and for training and target setting in implementing digital healthcare services.

Keywords: • Healthcare • Digitization • eHealth • Value Co-creation • Lean • Standard Work •

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1 Introduction

Governments and healthcare organizations in many countries are looking for ways to transform traditional healthcare services and to develop new services within a digital format. There is strong impetus for this development from legislation and government target setting to increase service availability and to deliver those services cost effectively (Moen et al., 2012; Christensen, 2010; OECD, 2013; Martin, 2009).

For healthcare organizations with limited resources, the ever-increasing demand for healthcare services and the complexity of customer situations present huge challenges (Hickie et al., 2007; Christensen et al., 2010). Digitization offers new possibilities in meeting these challenges, as more active, empowered customers interact with healthcare professionals (Lerch et al., 2015), requiring the redesign of service processes.

Digitization of health care services is typically discussed from a technological, medical science or customer perspective, and the role of the service provider is less widely studied. The present study aims to enhance understanding of how service providers can address issues of service process change through digitization. For value co-creation, the service provider must consider certain risks and seek to enhance identified benefits, which are dynamic rather than static, making the development of digital services more complex. Risks in the health care service process are often linked to issues of quality, which in this sector relates to the fundamental need for security and high standards of care (Black et al., 2011; Dahlgaard et al., 2011). In digital format, risks of quality failure or variation can be said to diminish as the service is standardized and variation can be controlled (Kenney, 2011; Barnas, 2014; Grunden, 2012).

Digitization entails a technological approach to customer and service issues, but the managerial dimension must also be considered. The present study contributes to the discussion on digitized healthcare services by highlighting the need for standardization of work processes. The DARIO value co-creation model of digitized services described here is derived from Prahalad and Ramaswamy's (2004a) value co-creation building blocks. The key development is the model's focus on service processes implemented through standardized work, providing opportunities for value co-creation.

2 Literature review

Healthcare service systems are transforming rapidly to become more customer-focused, shifting from value proposals to systems of value co-creation (Vargo et al., 2008a). This shift is strongly supported by the changing role of the customer and significant technological developments, offering opportunities for secure and collaborative value co-creation. For health care professionals, the challenge is to integrate digital healthcare services with the overall service process and operations, which inevitably become standardized through digitization.

2.1 Value co-creation

According to service-dominant logic, both customer and service provider become resource integrators in value co-creation (Vargo et al., 2008a; McColl-Kennedy et al., 2012; Ostrom et al., 2015; Moeller 2008; Vargo et al., 2016). Service-dominant logic further designates the customer as the focal actor in defining value (Vargo et al., 2008a). The customer's perception of value relates not only to value as service outcome but also as experience or value-in-use (Grönroos et al., 2013; Payne et al., 2008; Vargo et al., 2008a). In a healthcare context, value is generally understood as the outcome of the service process, but the customer experience during the treatment process and the value co-created during the process is seen to be of even greater relevance, irrespective of the final outcome.

The changing role of the customer also changes expectations about how healthcare services are delivered, requiring a shift of mindset in service development. Digitization brings the customer into focus, and the digital service process offers mechanisms supporting value co-creation (Saarijärvi et al., 2013; Vargo et al., 2014). In a knowledge-intensive sector such as healthcare, the service provider is especially well positioned to influence the process of co-creating value with the customer through professional expertise and knowledge.

As well as interaction, value co-creation involves processes in which the service provider and the customer operate independently in their respective domains (Payne et al., 2008; Grönroos et al., 2013). The nature and existence of these independent processes is of course arguable, as according to Grönroos et al. (2013), value is always co-created only in direct interaction—in other words, there has to be simultaneous interaction between the stakeholders in value co-creation. However, as well as value related to the service provider-customer interaction, there is also value derived from or related to the service process that is actually co-created among stakeholders other than service provider and customer. These independent domains include processes that for the service provider involve co-creation opportunities (Payne et al., 2008), planning and implementation and metrics connected to implementation. For this reason, the service provider can exert significant influence on the creation of customer value by providing opportunities for value co-creation (Payne et al., 2008).

Digitized services provide opportunities for mutual benefits, with joint targets set for the entire process according to the principles of value co-creation (Vargo et al., 2008a; Payne et al., 2008). The dialogue between customer and service provider itself becomes an ongoing element of the digitized service process (Pralhad et al., 2004b; Vargo et al., 2008b). Further, digitization increases potential availability of the service as well as better customer access by departing from the traditional direct appointments approach. In addition, risk-benefit evaluation is considered a further building block of value co-creation (Pralhad et al., 2004a) and can be utilized to analyse the impact of digitization on the service.

Shared information is one element that enhances the service system by creating opportunities for value co-creation. Digitization creates these opportunities by establishing a platform for sharing information, so introducing transparency to the service process (Maglio et al., 2008; Vargo et al., 2008b; Akaka et al., 2014). In healthcare settings, transparency is closely linked to shared information and to the related concept of shared-decision making (Carman et al., 2017; Gulbrandsen et al., 2016; Hoffman et al., 2014). Based on shared information that the service provider contributes to and facilitates, the customer is empowered to participate actively in shared-decision making. However, transparency does not necessarily deliver value for the customer unless the digital service process is properly integrated into the practical operations through which concrete value co-creation opportunities emerge (Hickie et al., 2007; Martin, 2009). The digital service process requires a new way of operating and a different approach on the part of the service provider. It is therefore necessary to properly define the new processes and to integrate the digital service portal into the service process and operations to ensure that professionals do not act sporadically on the basis that “it is just a gadget or a tool” (Lapão, 2016; Hickie et al., 2007).

Given that transparency can be seen to relate to information and to operations, which differ in certain respects, the present study proposes a modification of the DART model (Pralhad et al., 2004a) in the form of DARIO, a new value co-creation model. As described in Figure 1 below, DARIO operationalizes the concept of transparency into information and operations as two distinct features introduced by digitization for value co-creation and the development of digitized services. The model’s key contribution is the focus on service operations through customer activities within the portal and the professional’s standard work as opportunities for value co-creation (Payne et al., 2008).



Figure 1: DARIO model of value co-creation in digitized services

As indicated, operations are an essential contributor to value co-creation, as both customer and service provider use the digital service portal, offering opportunities for value co-creation. For the service provider, operations represent an organizational aspect of value co-creation, as processes and practices need to be integrated with digital processes to operationalize the service. Many eHealth services fail because insufficient attention is paid to actual implementation of the service (van Limburg et al., 2011; Lapão, 2016; Hickie et al., 2007). Based on the value co-creation definition of the customer as the focal value-defining actor, operations must be value-driven—in other words, digital service processes must be developed in close cooperation with the customer, enabling work processes to be successfully integrated. However, developing digital solutions customer needs and changing capabilities require that development is a continuous process, including re-evaluation of processes following actual implementation.

2.2 Operations as standardized service processes

The present study views the service provider's operations as an opportunity for value co-creation and as an element of that value co-creation. Digitization of healthcare services requires effective implementation so that the service provider or the professional can integrate the digital service portal with operations, enabling value to be co-created. If implementation of the digital service portal is not given due consideration but is instead seen as something that "just happens," implementation may fail or fall short of its full potential for service delivery due to a lack of proper planning (Lerch et al., 2015; Hickie

et al., 2007; Christensen et al., 2010). Here, implementation means successful integration of the digital service with the overall service process to ensure seamless care. Professionals who must learn new ways of interacting with the customer do not always receive sufficient support to ensure successful implementation, and the consequences for professionals' work must be carefully considered and planned in the development phase of the digital service portal.

Many healthcare organizations have made huge advances in their operations through standardized procedures and defined targets based on the lean method (Kenney, 2011, Barnas, 2014). Lean is based on continuous improvement and a focus on people, both customers and personnel (Womack, 1996; Grunden et al., 2012). Lean essentially means following the customer's path through the service process and monitoring that process through the customer's eyes to become a customer-centered service organization (Rasche 2017). Following the customer path through the service process and developing and planning the new process contribute to more successful implementation of the digital service.

Lean philosophy takes the customer as the starting point for the organization's operations and processes. Understanding the customer's actions and path through the service process are the key objectives for lean value stream mapping (Womack, 1996; Kenney, 2011; Barnas, 2014). Value stream mapping as a lean tool starts from the customer at the threshold of the service process and follows on through operations, multiple interaction points and sub-processes that the customer encounters. Taking the customer as starting point in the planning of the digital service process is closely analogous to the founding premises of value co-creation. For the service provider, this means keeping the customer in view when developing service processes and operations or work processes. It follows that planning for implementation of the digital service should consider the professional work processes with which use of the digital service portal must be integrated.

Risks in the health care service process are often associated with issues of quality. The requirement for quality reflects the requirement for security and high standards of care and treatment (Black et al., 2011, Dahlgard et al., 2011). In the digital service format, the risks of quality variation or failure arguably diminish as the service is standardized, enabling variation to be controlled (Kenney, 2011; Barnas, 2014; Grunde et al., 2012). By the very nature of the technology, digitization necessitates definition of work processes and operations. Further, according to lean philosophy, the operations defined in the digital service format help to reduce the risks of quality failure or variation, as the service process becomes standardized and variations can be controlled.

The concept of standard work refers to how professionals perform operations in a unified and similar way. Standard work looks to create a consensus in the practice of procedures and operations to reduce any variation among practicing professionals. Reduced variation of treatment increases the consistency of quality of operations and outcomes (Kenney, 2011; Barnas, 2014). Standard work is very often misunderstood as excluding the

possibility of interpretation and the use of professional expertise. However, this is not the objective; on the contrary, standard work reduces wasted time and effort in the service process and so releases the professional's time and expertise to make a more meaningful contribution to the service process. Digitization of processes can too easily be regarded as a threat to professionals' work, and more emphasis should be placed on how a standardized work process facilitates non-routine work requiring advanced expertise and knowledge (Gregorio et al., 2008; Lapão, 2016).

3 Methodology

The study is based on single case data gathered from a large healthcare organization, using the qualitative methods of thematic and focus group interviews. The single case study facilitates exploration of an industry embarking on a new approach to value creation and implementing processes for value co-creation opportunities through digitization. It is also appropriate when studying a new phenomenon under unusual or (as here) complex circumstances (Eisenhardt et al., 2007). The material obtained through the interviews was further enriched by observations within the organization while participating in two seminars and workshops on digitizing healthcare and its services. The organization in question identified mental health and weight control digital services development groups, from which the interviewees were drawn. Participants in the thematic interviews were selected by means of snowball sampling (Salganik et al., 2004), with each interviewee identifying the next. Interviews continued until the information gathered became repetitive and no longer added to the information from previous interviewees. There were two focus group interviews, involving mixed combination of people who were active participants in the development of these digital healthcare services.

In total, 26 people participated in the individual or group interviews. The observations in seminars and workshops consisted of several discussions and workshop tasks with multiple health care professionals who were interested in or participating in digitization of healthcare services. The personal thematic interviews were tape-recorded, and the group interviews were video-recorded with participants' permission. The recorded material was typed, grouped and organized, utilizing the guiding thematic issues for the purposes of analysis. The material casts light on the attitudes of the organization and its professionals toward digitization, and on understandings and measures concerning the need to define internal processes to meet the challenge at the customer interface for value co-creation.

4 Findings

The case organization has several ongoing projects developing digitized healthcare service portals. Very often, implementation of these services would not progress or even seem to fade away because of deficits in service process integration planning, poor understanding of the implications for work procedures and low managerial commitment to implementation. This lack of managerial commitment owed to uncertainty about the

new workload and the inability to set clear targets for implementation. While the organization has made significant efforts and there has been substantial development work, the implementation process is slow.

“We don’t know if this service is useful or not. We cannot proceed, as we don’t know whether it will overstretch us.” (Physician, workshop participant)

The development groups comprised voluntary participants, ensuring their motivation and commitment to developing the services. However, voluntary participation also means that management commitment may be low. While some development groups proceed well and people are committed, there are others whose work lack management commitment, and the lack of sufficient organizational participation resulting in poor planning and potential failure of implementation.

“This is a journey toward understanding what this could mean for us.” (Project director, ICT digital services)

Based on the interview findings, it seems obvious that careful planning of digital service processes is fundamental for successful implementation enabling value co-creation.

“You have to plan changes in the way of working before implementation.” (Project Manager, Administration, Development activities)

There are now ongoing efforts to formalize the development work based on a strategic approach to which services to digitize, how to proceed with planning and whom to involve in development. However, there is an evident lack of experience within the organization in defining services, service processes, roles and work descriptions, which is rather resource bound for ICT supporting this development work with less support from the management or from the human resources organization.

“We proceed with the lean plan-do-check-act of continuous improvement, with small steps in the development work.” (Project director, ICT digital services)

The organization utilizes lean methods for digital service development, involving both personnel and customers. Services are planned and developed on the basis of a customer forum of customer experience experts—that is, real customers for the services to be digitized. For the professionals, defining the service process for digitization introduces the concept of standard work, which assures quality and reduces waste in the process such as missing or lost information, which are also essential features of digitization.

“Standard work is also standardization of the work environment.” (Project director, LEAN projects)

The planning of digital treatment paths is an iterative process, and courage is required in order to learn through an iterative process.

“We learn from our experiences and utilize that in subsequent services.” (Quality manager, ICT project office)

Results improve each time and enhance the functioning of the digital service process. However, training for new work processes remains secondary in terms of planning, although its importance for the successful implementation of the services has been recognized.

5 Discussion

5.1 Theoretical and managerial contributions

The study findings can be discussed in terms of the DARIO model, which links transparency to information and operations as indicated in Figure 1. This more precisely captures what the service provider must consider for successful value co-creation in digital services. The DARIO model contributes to the discussion of digitization of healthcare services, which requires new cross-disciplinary inputs.

The findings have several managerial implications. The service provider, who has a huge impact on value co-creation opportunities, must also be a resource integrator—that is, they must be able to integrate the digital service into the overall service along with defined work processes and standard work. This highlights the importance of developing digital services through close interaction between customers and professionals. The development of digital services is based on voluntary involvement by the participants in the development groups. However, from a managerial perspective, this voluntary participation fails to deliver the necessary understanding of the digitized service process to the organization and of the related workload to management. The findings suggest that a lack of clear targets for implementation, including voluntary participation in the development work, hinders integration of resources, which further slows the implementation process and increases the risk of low adaptation. Both of these effects undermine achievement of the ultimate targets of increasing service availability and cost effectiveness in the delivery of healthcare services. Based on these findings, there is an imminent need for systematic involvement of management in the development processes and in defining targets for implementation in terms of number of users and timespan for integrating the digital service within the overall service.

The mental therapy service offers a huge range of possibilities to proceed with the customer. There seems to exist uncertainty of and lack of a common description for the proceedings how to combine the digital mental therapy service with sufficient amount of empathy and presence. With the weight control house these are services for various combinations of conditions like anorexia or severe obesity with linkages to mental

therapy services as often there is a connection with these issues. During the interviews or in the focus group interviews there was less remarks on the implications to work processes or operations in general concerning the mental therapy services or weight control house services. However, as digitization changes these work processes and service operations tremendously, there emerges a need to redefine work processes or the work. Algorithms behind the service process guide how the service proceeds, but these do not define operations or how the professional integrates the digital service portal into the service process. Lean's standard work introduces a coercive formula to follow a defined work process in the digital service portal.

These findings suggest that the organization still lacks the necessary systematic planning for implementation of the service portals of mental therapy or weight control with defined standardized work processes and training for the professionals for integration with the overall service processes. This suggests a need for systematic involvement of management in defining implementation, training and standardized work in order to gain commitment and ensure successful implementation and value co-creation opportunities within the service process.

5.2 Limitations and directions for future research

The study has several limitations. The first of these relates to the theory-building process. An approach combining value co-creation and lean standard work through operations may seem risky, as there is no readily available theoretical precedent, and the model can therefore be considered limited in this regard. Nevertheless, the idea of combining value co-creation and lean offers multiple possibilities for future research. Second, the focus here is on single professionals and their standard work; multiprofessional teams were not considered because of practical constraints. This limitation invites more thorough and separate research on standard work in multiprofessional teams in the context of digital healthcare services. Third, there was no possibility of studying customer operations within the digital service portal for practical reasons of permissions and the need to focus on the professionals. However, customer use of the digital service portal represents an interesting and fruitful area for further research.

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IT on the Shop Floor - Challenges of the Digitalization of Manufacturing Companies

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Abstract A new generation of information technology (IT), promises significant benefits for manufacturing companies in their daily work. However, the companies are rather slow in taking advantage of the opportunities offered by the current wave of digitalization. This paper starts with an overview of emerging sociotechnical trends in manufacturing. We discuss technology as catalyser of this transformation process and its impact on individual and organisational levels. The intense collaboration with six manufacturing companies in a European project allowed us to identify and further specify four digital challenges: 1) Digitally augmented human work, 2) Worker-centric knowledge sharing, 3) Self-learning manufacturing workplaces, and 4) In-situ mobile learning. The four digital challenges illustrate how companies (can) embrace emerging sociotechnical trends in manufacturing and thus contribute to a better understanding of the changing role of IT on the Shop Floor.

Keywords: • Digitalization • Smart factories • Shop floor • Industry • Manufacturing • Sociotechnical • Trends • worker-centric • knowledge sharing • in-situ mobile learning •

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1 Introduction

The ever increasing global competition leads industrial companies to engender organisational changes and drive innovations. A new generation of information technology (IT) can contribute to the transformation of the shop floor: on the one hand by advancing the automation of manufacturing processes (Armbruster et al., 2007; Brettel et al., 2014; Chi, 2013) and on the other hand by putting shop floor workers and their skills more in the focus (Campatelli et al., 2016; Steinhüser et al., 2017).

However, so far, manufacturing companies have been slow in taking advantage of the possibilities offered by the current wave of digitalization (Hessman, 2013). Yet, we know little about the information needs and possible benefits of IT for the manufacturing sector (Daeuble et al., 2015).

Therefore, the goal and main contribution of our study is to identify, describe and explore current challenges that companies are facing due to emerging sociotechnical trends in the manufacturing sector. For this context, we define a digital challenge as the combination of 1) the identification of the problem situation 2) the implementation of a sociotechnical solution to address the problem and 3) the continuous transformation of the existing work practices.

We start this paper by presenting emerging sociotechnical trends that are currently engendering changes in manufacturing. We start by discussing technology as catalyser of this transformation process and then discuss its impact on individuals and the organisation (Chapter 2). In Chapter 3, we explain how the close collaboration with six industrial companies in a European project for more than two years (so far) has allowed us to identify and then further specify four digital challenges. Those are 1) Digitally augmented human work, 2) Worker-centric knowledge sharing, 3) Self-learning manufacturing workplaces, and 4) In-situ mobile learning).

Next, we illustrate each digital challenge with an example of a company from the project. For each case, we describe the problem situation and then the proposed solutions to overcome problems being faced by each that have been implemented or are currently implemented. Thus, drawing on the insights from these companies we demonstrate how the manufacturing industry can leverage challenges they are experiencing. Beyond practical relevance, this conceptualisation of the current situation as “digital challenges” for manufacturing companies helps building the basis for a better theoretical understanding of the changing nature of IT on the Shop Floor.

In Chapter 5, we discuss how to take a step forward by proposing sociotechnical solutions for the workers in response to these digital challenges, to support their work practices and increase job satisfaction.

2 Emerging sociotechnical trends in the manufacturing sector

In the following, we present sociotechnical trends that emerge in the context of manufacturing. In order to identify these trends, we thoroughly reviewed the latest literature, the public media as well scientific publications. We categorize the trends into three pillars, as summarized in Figure 1, and discuss them in the following sections: (1) Technology, which is the basis for this transformation and catalyses the other changes on (2) Individual and (3) Organisational levels.

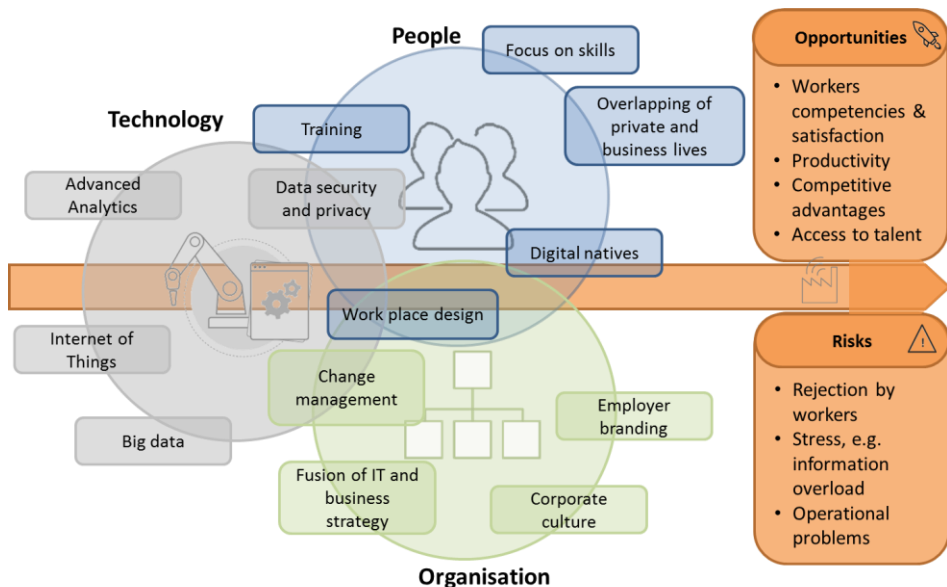


Figure 1: Emerging sociotechnical trends in the manufacturing sector

2.1 Technology

New technological developments can serve as drivers for change on organizational and individual levels (Köffer, 2015). The following recent technological trends have the potential to substantially affect the workers’ situation on the shop floor and also the organisation of manufacturing environments.

The web-based linking of machines, sensors, computers, and also humans, is rapidly moving towards the idea of the connected factory (Bono and Pillsbury 2016). The benefits of the so-called “Internet of Things” (IoT) technologies include reduced down time, increased quality and less waste as well as greater visibility of the manufacturing floor. This connectivity enables companies to leverage the value of their plant floor information and promises an increase in productivity, improved utilization of assets, and better decision-making (Bradley, 2015). Whereas recent technical advances in interoperability

have resulted in higher maturity of product and process models (Tibaut et al., 2016), companies still face the task of building coherent services when the individual components are technically different and managed by different units.

IoT technologies allow devices to communicate automatically and enable companies to monitor, collect, process, and analyse huge amounts of data, which may lead to more precision and the chance to get deep insights into manufacturing processes. Measuring and monitoring real-time data from across the factory leads to rapidly growing data sets that are increasingly gathered by cheap and numerous sources and often so large or complex that traditional data processing applications are inadequate to deal with. In this context, the term big data was coined. To capture business value and meet the demands of smart manufacturing, companies need to be able to manage these large data sets and extract meaning out of them (O'Donovan et al., 2015). This large quantity of data leads to new questions and solutions concerning especially the analysis, search, sharing, updating, and visualization.

Advanced analytics in the form of predictive analytics, user behaviour analytics, or certain other methods that extract value from data, are needed to cope with this great amount of data (Lee, 2013; Wambaa et al., 2015). It offers possibilities to make extensive use of analytical tools often capable of providing diverse reporting on any device, anytime. These tools are able to deliver data about companies' productivity and security as well as supporting decisions according to product configurations, service bundles, and pricing options. The utilization of metrics is evolving at a rapid pace and will become even more pervasive in the future (Van Herreweghe et al., 2015). Danson et al. (2016) state that "industrialized analytics" is increasingly influencing business strategy and commanding substantial investment and connecting analytics capabilities is crucial for manufacturing companies.

2.2 Individual Level

As with any new way of working, or even more general - of doing - individuals need to learn and adopt it, get used to it, and, in the best case, benefit from it. Striving towards a smart factory may have an enormous impact on work practices on the shop floor. Employees face changed processes, they need to handle new technologies and accomplish different tasks. As one out of three trends for the future of manufacturing the World Economic Forum, therefore, identified the focus on the workforce's skills (McNelly, 2016). With the spreading and growing importance of technology in the manufacturing sector, the need to be able to acquire new skills to get the work done properly increases. Individuals are not only facing changes of technologies, but, as a consequence, also the increasing complexity.

Providing workers with information where and when it is needed and, more generally speaking, supporting the employees in their daily work promises significant benefits (Daeuble et al., 2015; Mavrikios et al., 2013). As a consequence, shop floor workers are

expected to solve occurring problems as fast as possible and to constantly improve their work-related knowledge and skills (Appelbaum, 2013; Ullrich, 2016).

People who were not born into the digital world have learnt to use different kinds of technology at some stage in their adult lives and are likely to experience some difficulties in accepting technology related changes at work. Conversely, the “digital natives” have grown up with diverse IT. The entering of digital natives into the workplace might mark a paradigm shift (Vodanovich et al., 2010). The way people process information fundamentally differs and depends from how and when they grew up. Thinking patterns have changed and it is very likely that even their brains have physically changed (Ng, 2012; Wang et al 2012). It could be shown, that this implies an ease with which digital natives learn to make use of unfamiliar technologies (Ng, 2012; Wang et al., 2013). They need, however, to be provided with the opportunity to use them for meaningful purposes (Huyler et al., 2015). In order to remain competitive, companies need to take this into account.

Another perspective on the same phenomenon is that some employees may be faced with fears about whether digital natives and smart machines will soon take over their jobs (Brynjolfsson and McAfee, 2011). However, humans with the most diverse skills and competencies as well as with valuable experience have always added value to manufacturing processes and this is likely to continue (Gorecky et al., 2014). There is a variety of possible ways in which people and machines will work alongside each other (McAfee and Brynjolfsson, 2014). Of course, some will build, implement, maintain, and operate upcoming technologies. Others will be in roles that machines can’t perform well, such as those involving high levels of experience, intuition, creativity, or empathy (Danson et al., 2016). Therefore, manufacturing companies should not overvalue digital skills at the expense of “traditional” skills. Instead, they are advised to recognize and promote experience and handicraft talent, too. Focusing on all different kinds of skills is a great challenge but it may create advantages for manufacturers, and also positively impact workers’ employment and incomes (Daugherty et al., 2016). When facing this challenge appropriately it is important to rethink and develop group specific learning arrangements and individual work place designs (Köffer, 2015). Organizations will need to examine knowledge-intensive processes and determine which tasks can best be performed by machines and which by humans (Gorecky et al, 2014). Early training and supporting employees to prepare for a collaborative future with smart machines is essential (Danson et al., 2016).

2.3 Organisational Level

The exponential growth of data and the convergence of different affordable technologies are transforming organizations. Key infrastructures are underlying considerable changes that play a vital role in securing competitive positions in the manufacturing industry. Anytime retrieval, monitoring and operating of technology infrastructures, even over huge physical distances, enables simultaneous control and coordination of complex

technological processes. Consequently, a shift can be observed, away from centrally controlled processes towards decentralized, distributed structures and processes. As a result, today's strategies, value chains and business models will come under increasing pressure (Kagermann, 2015). Companies need to decide whether to react on emergent demands or to proactively contribute to a transition's design or they can choose between an incremental change versus a radical change (Ullrich et al., 2015). In each case an appropriate change management is crucial.

The prevailing view of IT strategy has mostly been that it is a functional-level strategy that must be aligned with a company's business strategy. The business infrastructure has become digital, though, with increased interconnections among products, processes, and services. The arrival of IoT, Cyber-Physical Systems (CPS) and others allows everything to be networked in order to create a smart environment where people and machines communicate with each other naturally (Kagermann, 2015). This has led to fundamentally transforming not only business processes, products and services but also business strategies. Accordingly, the role of IT strategy has to be rethought, from that of an aligned but subordinated functional-level strategy to one that reflects a fusion between IT and business strategy. Key themes to guide this are, the scope, the scale and the speed of digital business strategy, as well as the sources of future value creation and capture in digital business strategy (Bharadwaj et al., 2013).

When addressing a change in strategy, its success strongly depends on a firm's ability to evolve its corporate culture. Thereby, companies are advised not only to take advantage of emerging technologies, but also, critically, to embrace the new business strategies that those technologies drive. Enterprises must focus on enabling people to accomplish more with technology (Gorecky et al, 2014). They will have to create a new corporate culture that looks at technology as the way to enable people to constantly adapt and learn, continually create new solutions, drive relentless change, and disrupt the status quo. In times where the focus is locked on technology, it is important, in fact, to place people first (Daugherty et al., 2016). Thus, it is the task of managers to promote an organizational climate that supports decentralized and self-responsible use of information assets. For this, many leaders are likely required to develop new skills, resulting in training recommendations for supervisors, who have a prominent position in digital workflows (Köffer, 2015).

The rise of the generation of digital natives, as stated above, brings a new kind of employee not only with different attitudes towards technology but also with different outlooks, aspirations, and expectations regarding their employer, their workplaces, and about how work should be organized (Wang et al., 2013). It appears that preferences are shifting towards aspects such as connectivity, information or entertainment (Hanelt et al., 2015). The push towards new forms of working challenges organizations. On the one hand, it is important to thoroughly plan and execute the change, on the other hand, there is strong competition between manufacturers for new employees. A successful employer branding would create sustainable competitive advantages. With the right engagement

strategy, companies can leverage the excitement for technology, teamwork, and digitalization of younger employees to push forward the business (Daugherty et al., 2016).

3 Research Design

This study is a part of the international research project FACTS4WORKERS. The objective of FACTS4WORKERS is to create attractive and intelligent work places in a factory of the future. Therefore, we initially studied how practices on the shop floor can be supported through human-centred IT solutions. A deep understanding of workers' individual practices has been our basis to deliver suggestions (in the form of requirements) for sociotechnical solutions that support smarter work.

Guiding through the process of exploring smart factory solutions, we identified four digital challenges together with our six industrial partners from the manufacturing domain. The identification was done in the constitutional phase of the project by conducting a focus group with all six companies. The intense collaboration with the companies over a span of more than two years allowed us to deepen our understanding and to further explore the four specific digital challenges.

Further field studies at each of the six companies enabled us to collect data from more than 60 interviews, various observations (also documented by more than 100 photos and 20 videos) as well as at least one further focus group at each partner. For further information about first phases of the data collection please refer to (Heinrich & Richter 2015) and (Denner et al. 2015). This has all contributed to describe their individual challenges in more detail.

4 Digital challenges for manufacturing companies

The role of knowledge in manufacturing companies has grown over the last century and innovations and technologies have changed it radically a number of times (Wan et al., 2014). Currently, the focus has drifted towards knowledge-intensive and human-centred manufacturing. Currently and in the future, human workers have an important role in manufacturing environments, as they are capable of complementing modern technology and performing knowledge-intensive work tasks more effectively compared to solely technical approaches. However, this also will require more knowledge management skills from the workers and manufacturing environments.

The data gathered from six companies allowed us to identify four digital challenges: 1) Digitally augmented human work, 2) Worker-centric knowledge sharing, 3) Self-learning manufacturing workplaces, and 4) In-situ mobile learning. These fall into different facets of knowledge management. While for example predictive manufacturing focuses stronger on the technological aspects of knowledge aspiration, human-centred manufacturing rather focuses on the social aspects (cf. figure 2). Beyond identifying the

digital challenges we illustrate all of them with a case vignette each – that gives insights into the situation at the industrial partners’ production environments.

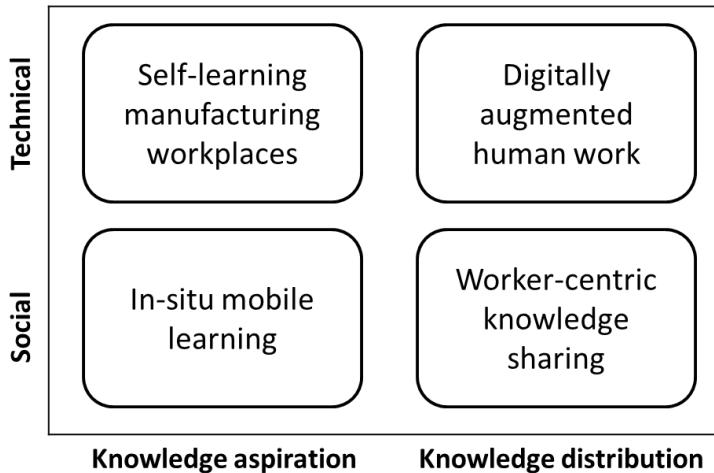


Figure 2: Digital challenges for manufacturing companies

4.1 Digitally augmented human work

Human shop floor workers deal with information that is increasingly more complex and transforming, combined from multiple sources and types. Augmenting human work with digital technologies means to provide them with an immediate and personalized provision of information at the shop-floor-level, which can be interacted (accessed and modified) according to their needs, roles, preferences and constraints (Kagermann 2015). Our research reveals, that one common request of many assembly and manufacturing workers is to have a better awareness of the process status in order to have a more conscious decision making process and increase their responsiveness to process breakdown/change. To date in many companies the operators need to actively seek the required information and select the correct information from a large number of data sources to carry out their tasks.

Thus, the main idea of the challenge is to create a “personal” information feed for a specific worker that could support his activity and empower him to become a smart worker with more autonomy and problem-solving capabilities. The solution should provide also the appropriate tools not just “see” the correct data but also to analyse them in the smartest and personalised way. Not only the access to data has to be personal but also the analysis should be developed and selected in order to provide an understanding of the process that will be profitable for the specific worker.

Case vignette 1

Hidria Rotomatika is a Slovenian automotive tier-1 supplier that produces electric stators and rotors for automotive use. We observed operators of the machining departments, who deal with turning and milling machines.

A preliminary analysis of the workers needs has highlighted how some operations could be time-consuming and require the acquisition of paper-based data or knowledge from an experienced colleague. These data must be processed manually in order to obtain a smooth process. Especially machine setup processes and measurements of each part could be very complex and time-consuming. This challenge addresses the core issue of providing natural interfaces that allow workers to interact and access knowledge effectively when performing their regular tasks. The challenge is to enable the workers to utilize big data analytics fuelled by automated electronic measurements to make decisions more effectively when calibrating production equipment. Better access to information and analytics would allow to cut production times while increasing product quality and reducing waste due to making better-informed decisions and detecting patterns and trends in product deviations. For the worker, being able to benefit fully from information generated by machines and previous decisions could reduce frustration and help retaining a productive flow of work.

In the proposed solution, the workers automatically receive all relevant information in a digital format and obtain a fit solution to fix the problem directly at their current work station. Moreover, the operators acquire more autonomy due to the implementation of a trend analysis of the process, which usually means the degradation of some components or machines. In this case the operator becomes a leader of a proactive analysis phase for the machine maintenance that is actually carried out using a traditional reactive approach (repair actions when the process stops due to e.g. a broken part) by the maintenance team. This allows the operator to gain more autonomy and take charge of advanced tasks that are beneficial both for the process (higher availability of the plant) and its satisfaction (higher autonomy and possibility to be the responsible for the process well-being).

4.2 Worker-centric knowledge sharing

Worker-centric knowledge sharing means the utilization of worker-generated content and peer sharing about best practices, problem solving and ideas to fuel organizational learning and even worker-driven innovation (Richter et al., 2013). This includes not only equipping workers with appropriate tools, but also with specific use cases for utilizing these tools (Richter & Riemer, 2013). Empowering workers to share their knowledge transparently with others reduces the risk of productivity bottlenecks e.g. through redundant work and improves the pace and depth of on-the-job learning. At the same time, the worker feels more valued, more socially connected to the work community and better motivated.

Case vignette 2

thyssenkrupp Steel Europe is an international provider of flat steel. We observed the practices of the mobile maintenance team in the areas of air-conditioning technology and electricity.

The occurrence of a fault is reported via phone, email, or fax. Rough information on the type of fault and system is then passed onto the mobile maintenance employee in paper form. Frequently, neither local information of the production site in which the disruption is located nor particular safety instructions are provided. The necessary knowledge is usually acquired through the accompaniment of an experienced colleague or through systematic trial and error, despite a structural knowledge transfer. Since approximately 3,000 different types of systems must be serviced and possibly debugged, employees rarely possess all the relevant information, tools and spare parts to solve a specific problem without a considerable communication effort or multiple journeys. The direct communication in the process of fault elimination is currently supported by mobile phones without access to mobile data. The paper-based, asynchronous information exchange between the employees who are involved in the fault process often leads to delays or redundant work. Furthermore, at the site of the disruption, there is often a lack of knowledge that other employees could deliver. In this case, the opportunities to directly communicate with other colleagues, e.g. to exchange pictures and documents, are missing.

Due to the above-mentioned mobility and the numerous and varied challenges which the maintenance personnel faces, it is important that the workers are provided with the necessary information in a bundled, contextual and mobile way. This will be realized through the implementation of a mobile employee-centred knowledge management system that places the maintenance staff at the centre of attention. The solution can provide necessary information on maintenance in two ways: 1) Context-specific information on all systems can be called up by the employee through a mobile information system. 2) Access to colleagues' practical knowledge can be realized through a chat function with the possibility of exchanging images and videos. These two components support the maintenance employee on his way becoming a smart worker who has access to all necessary knowledge. Through this form of knowledge networking, the communication between colleagues can be increased, practical knowledge exchanged and the process of eliminating faults thereby designed in a more efficient way. Due to the accessibility of relevant information, unnecessary journeys can be avoided and the certainty in the employees' actions increased.

4.3 Self-learning manufacturing workplaces

Self-learning manufacturing workplaces support workers discovering and sharing knowledge during manufacturing, enhancing their competencies and worker satisfaction. However, the manufacturing knowledge and information is currently often scattered

across a plethora of information silos without a centralized platform to connect, combine, analyse and organize the information according to the present needs of the shop-floor worker. Mastering the complexity of data and information requires sophisticated semantic and data mining technologies to discover the relationships between different sources (Zhong et al., 2015), allowing intelligent search and exploration. With the implementation of advanced IT solutions, IoT technologies and sufficient knowledge management procedures, new possibilities for leveraging the manufacturing knowledge arise.

One such concrete advance is the creation of a self-learning manufacturing workplace. Utilizing detailed and consistent data from manufacturing operations, enterprises are able to implement e.g. predictive maintenance and machine-assisted decision making for calibrations that allow reducing unplanned process disruptions and maintaining a smooth workflow (Orio, 2015).

Case vignette 3

Hidria Technology Centre is a Slovenian company, which designs and manufactures a wide spectrum of partially or fully automated assembly lines, ranging from simple conveyer belt designs to fully automated lines. These complex and automated manufacturing lines incorporate lots of fault conditions. The loss in efficiency is due to either time-consuming setup and maintenance activities or lacking supplies. In such cases, the line comes to a halt or produces parts that have not been specified. The increase of operating time and the reduction of maintenance time of the assembly lines are therefore in the focus.

The main worker needs in this case are derived from one of the customer's sites: Hidria Dieseltex plant, which produces glowplugs and pressure sensors. One of the challenges in this case is that operators at the shop floor cannot predict up-coming problems or breakdowns, but instead they work mainly on tasks related to reactive maintenance. Thus, supporting tools for shifting operators' workloads towards more predictive maintenance tasks are desired. Further, operators have to react quickly to resolve problems during manufacturing. The team of operators aim to directly fix small problems like the replacement of defective parts. With larger defaults or more complex problems, the internal maintenance team helps to bring the production up to speed again as quickly as possible. Thus, in this case it is aimed at better supporting the problem-solving activities of the line operators by a new integrated knowledge base of the production line fault analysis. In addition, the solution finding to a problem/breakdown is highly dependent on the experience of the worker, and this knowledge is important to be shared also to less experienced workers for enhancing peer-learning at workplaces. The information and knowledge of manufacturing processes, technologies and solutions is currently scattered across the factory without a centralised platform to store, share and analyse the information according to the present needs of the worker at the shop floor.

A proposed self-learning approach will monitor a combination of human, process and machine parameters, and supports human-machine interaction. The solution offers: 1) a reactive (alarms), 2) predictive (warnings) and 3) proactive (maintenance) decision support to shop floor workers. Reoccurrence of problems will be minimized by storing and sorting the problems systematically and combining them with user generated solutions into the machine book – thereby enabling self-learning workplaces. The solutions to a specific problem can also be rated by the workers. In addition, an employee can generate new solutions in forms of comments, videos or pictures. As a conclusion, self-learning manufacturing workplaces are able to increase the workers' autonomy and competence by providing them the knowledge required for carrying out specific tasks.

4.4 In-situ mobile learning

The increasingly needed flexibility of workers leads them to perform a wider range of tasks and share more responsibilities in manufacturing (Appelbaum 2013). This causes the pervasive need of overall on-the-job knowledge, available at the right time in the right place. Furthermore, knowledge is subject to continuous change as work practices evolve and requirements change. So far, declarative and often abstract generic knowledge is acquired “off-the-job”, and it appears that this gap can be bridged by mobile learning in the right context (Aehnelt & Wegner, 2015; Frohberg et al., 2009; Ullrich, 2016). Workers need context-aware learning in real-life situations for continued education and training.

Since in-situ learning is relatively new to manufacturing environments, the challenge includes finding the optimal way to utilize contextual and real-time machine-generated data, and to design and deliver the learning service so that it is effective, efficient and widely accepted.

Case vignette 4

Schaeffler is a large German automotive supplier. The studied plant recently changed the former functional shop floor organization towards a new value stream design.

Along with these organizational changes came changes to the role of the individual worker. Formally deeply specialized personnel now works in diversified areas requiring a variety of skills and knowledge. However, expert knowledge is still needed to solve tough problems. Currently there are three steps for competence development within the company: formal trainings for learning factual knowledge, mentoring for the transfer of expert knowledge and the learning directly on the shop floor within real working contexts right at the machines. In these settings, several problems surface: (1) the knowledge transferred in formal trainings is not directly related to specific workplace requirements. (2) Mentoring defines the learning content and its recipients only through specific circumstances. (3) Learning directly on the machine is difficult as the complexity of the problem often requires an expert onsite which induces a resource problem.

As a solution, a mobile learning approach enables the company to detach knowledge transfer from formal contexts and enables the learner to consume the knowledge when needed. Four core components allow individual, context specific learning and therefore facilitate a sustainable learning arrangement. 1) The learning system includes a sensory interface to the workplace, sensing the machine state as well as the operator. 2) An automatic evaluation of the incoming sensory data provides context- and situation-sensitive problem-solving and learning content. In case of an unknown or currently unresolvable problem, expert assistance is necessary. 3) In such cases the expert would be included into the situation virtually first using audio/video tele cooperation. 4) With the usage of wearable Augmented Reality (AR) devices, such as data glasses, the learning context becomes completely immersed into the work place and the current work situation. As the worker has both hands free, true parallel working and learning is possible. With the introduction of appropriate learning systems, the transaction costs for identifying and consuming necessary information can be reduced. Also, the breakthroughs in mobile device technologies over the past years now allow the design of innovative learning arrangements whereby the boundaries between working and learning will disappear in the future.

5 Discussion

In the last years technical infrastructures have become more and more sophisticated, with large bandwidth networks, affordable software solutions and large storing capacities. Notwithstanding, as we have shown in this paper, a number of sociotechnical trends lead manufacturing companies to change the way they work.

One of these changes includes designing people-centred workspaces that pay more attention to their employees and put them into the centre of their efforts (Campatelli et al., 2016; Steinhüser et al., 2017). Creating an environment that contributes to more efficiency and increasing workplace satisfaction requires more than just implementing appropriate technical solutions. As technology matures, the focus of IT development can shift from a largely technical perspective to a more holistic sociotechnical perspective. Rather than focusing on centralized computer systems and treating the worker as an entity, not yet replaced by machines, the humanistic view focuses on human-human interactions where IT serve as tools to deliver support for specific tasks (Nurminen, 1987). When we acknowledge that the human worker keeps a preferred role in future manufacturing systems through the ever-rising demand in complexity, knowledge work and decision making, the humanistic perspective might be the only sustainable point of view to take. Taking this view, it also seems easier to design for basic human needs as autonomy, relatedness and competence (Gagné & Deci, 2005; Spreitzer, 1997) as well as variety (Turner & Lawrence, 1965) in the first place, as these can be formulated as core objectives enabling a humanistic design approach.

Advances in technology and organizational themes as well as changes in the society are important input variables that stimulate the creative process of designing future work

environments. Although called “digital challenges” they have one common theme: Keeping the worker “in the loop” with appropriate information. Moreover, the digital challenges aim to extend the natural sensory reach and information processing capabilities of an individual human worker (self-learning manufacturing workplaces), the field of interaction, e.g. vision, touch or hearing (digitally augmented human work) and further aim to strengthen knowledge absorption capabilities of individuals (in-situ mobile learning) and knowledge distribution within communities (worker-centric knowledge sharing).

6 Conclusion

We started this paper with an overview of emerging sociotechnical trends in manufacturing that coalesce to establish new ways of work in smart factories. Technological advancements in terms of IoT, Big Data and others drive organisational change in a manner not previously seen. Organisations must simultaneously incorporate and leverage the increasing shifts in technologies whilst maintaining a corporate culture that facilitates the most efficient and effective work force. Consequently, employees on the shop floor are expected to adjust their work practices to take into account the changing technologies and increasing complexity.

Drawing on the detailed insights from six manufacturing companies that we gathered as part of a European project aiming to create attractive and intelligent work places in a factory of the future, we demonstrate how the manufacturing industry can leverage challenges they are experiencing. With this conceptualisation of the current situation as “digital challenges” for manufacturing companies, we contribute to a better theoretical understanding of the changing nature of IT on the Shop Floor.

The four illustrated digital challenges span a wide range and are capable of supporting different facets of the knowledge practices in manufacturing companies. Taking into account different knowledge management facets helps to better understand and meet the needs and requirements as expressed by prospective users moving them in the focus of the implementation efforts.

We have observed that workers expect new digital solutions to draw on what they already are familiar with from their private lives, e.g. designing, commenting, searching or networking functionalities in the style of well-known internet platforms. In this context, ICT seems to play more and more the role of a hygiene factor that supports the workers in an “invisible” way. This implies that the pure existence of a new solution is not in itself able to give increased satisfaction or lead to higher motivation, however dissatisfaction often results from its absence or inadequate design. This calls for more research that contributes to creating worker-centric factory solutions of the future.

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Airport Operations Modelling: Agent Based Modelling of Ground Crews

BLAŽ RODIČ & ALENKA BAGGIA

Abstract Contribution presents the results of design research project aimed at the development of a simulation model for regional airports ground crew operations using a novel hybrid DES-ABM approach. We have used DES methodology to model the aspects of airport operations that are static or outside the main scope of our model, e.g. flight traffic, and ABM methodology to model the operation of ground crews, where the scheduling and work processes are variable. Use of ABM allows us to model the dynamic aspects of ground crew operations, such as dynamic scheduling and assignment of crews to flights, making the model more realistic and more flexible than when using DES alone. The hybrid DES-ABM simulation model is to be used in a ground crew scheduling system development for validation and optimization of heuristic scheduling algorithms. The resulting model contributes to the knowledge of domain experts with measurable improvements of ground crew scheduling solutions.

Keywords: • airport operations • ground crew • simulation and modelling
• agent based modelling •

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1 Introduction

International airports are operating in a competitive environment. The requirements of low cost airlines and prevalence of cost-cutting measures in aviation is forcing airports to optimise their operations and reduce costs while still offering efficient and high quality airline and passenger services. Efficiency, quality and costs are conflicting criteria, presenting airports with a difficult optimisation problem.

To improve efficiency and reduce costs, an airport can optimize the availability, i.e. schedule, of resources used for passenger and airplane services. However, airports are complex logistics systems, and the analysis and optimization of processes can be a tedious and time-consuming task. Airport processes have their own specifics since they can be interleaved and can therefore not be analysed separately. Since they are also subject to frequent changes, they cannot be modelled with an exact mathematical approach.

A wide range of scheduling problems can be found in the airports and elsewhere in the airline industry. Scheduling problems in these environments do not have straightforward solutions. Their complexity varies according to the number of constraints addressed. Typical scheduling problems in the airport domain are: aircraft scheduling (Bian, Burke, Jain & Kendall, 2005; El Moudani & Mora-Camino, 2000; Gurtner, Bongiorno, Ducci & Miccichè, 2016; Yan & Chen, 2008), ground crew scheduling (Clausen, 2011), disruption management (Pereira, Fadigas, Senna & Moret, 2011)(Løve, Sørensen, Larsen & Clausen, 2002), aircraft landing sequence scheduling (García Ansola, García Higuera, Pastor & Otamendi, 2011; Tavakkoli-Moghaddam, Yaghoubi-Panah & Radmehr, 2012) or personnel training scheduling (Brucker, Qu & Burke, 2011). Particularly in the domain of personnel scheduling, the most popular type of scheduling problem is the aircraft crew scheduling, while the problem of ground crew has mainly been neglected. Nevertheless, if an airline wishes to produce a high quality service for their passengers, the ground crew is as important as the aircraft crew.

The aim of our research was to produce a viable approach to solve ground crew scheduling problem at the airport. The contribution of our research is an IT artefact used to automate workforce scheduling and shift generation at a small international airport. The system produces floating shifts adjusted to variation of workforce requirements throughout the day in a fraction of the time needed for manual schedule preparation, and allows dynamic rescheduling in case of unforeseen events or disruptions. In order to achieve optimal workforce deployment, we needed to minimize the criteria of personnel costs and aircraft delay costs. Prevalent methodology for this purpose is discrete event simulation (DES) methodology, which is well suited for well-defined processes. The dynamics of airport operations however requires a certain level of adaptability, and the modelling of adaptable business process requires a flexible methodology, such as ABM. In this research, we addressed the problem of ground crew scheduling in a more efficient and innovative way. A similar solution for a small airport in need of an adaptable system

with accurate feedback and the possibility of ad-hoc changes does not exist according to our literature research.

This paper presents the development of a novel hybrid DES-ABM simulation model of regional airports ground crew operations, which will be used for schedule verification and optimization, specifically for the optimization of workforce quantity present in work groups covering specific types of tasks during the working day at the airport. The simulation model can be used to support the scheduling process in international airport of similar size.

2 Literature review

Since 19% of delays in air traffic are caused by airport operations (Burke et al., 2010), these operations cannot be neglected. Diverse approaches and simulation studies have been presented in the literature. As discussed in Bazargan (2004), to efficiently cover the aircraft maintenance operations, aircraft were classified according to the stopover time. Based on the length of stopover, the entire maintenance program with exact numbers of technicians and daily shifts are proposed. Kleinman, Hill & Ilenda (1998) have used stochastic methods to calculate the delay costs in air traffic. Attempts were even made to influence the schedule of aircraft landings in order to balance the workload of ground staff. Boysen & Fliedner (2011) have tried to adapt the landing schedule in order to efficiently schedule the ground crew.

In general, most of the research in the area of airport operations is focused on optimization of airport surface operations (Weiszer, Chen & Stewart, 2015), in some cases divided into passenger-related tasks and aircraft-related tasks (Clausen, 2011). Most of the solutions for ground crew scheduling are focused on only one work group (Chu, 2007; Lin, Xin & Huang, 2015; Weiszer et al., 2015). Herbers (2005) covers some aspects of ground staff planning with proposed procedures for requirement planning. Some of the solutions are limited to fixed shifts and static demands (Lin et al., 2015), while others use mathematical models not appropriate for complex systems (Bazargan, 2004; Qi, Yang & Yu, 2004). In general, the approaches to shift planning and crew assembly often use assumptions with strongly limited validity, or deal with simplified problems, thus limiting wider practical applicability.

3 Methodology

3.1 Design science research

Design science research is a process of creating new knowledge through design of novel and innovative artefacts and analysis of their performance with reflection to enable improvement and understand the behaviour of aspects of Information Systems (IS) (Vaishnavi & Kuechler, 2015). According to Hevner, March, Park & Ram (2004), design science research in IS addresses the so called “wicked” problem, characterized by

unstable requirements and constraints, complex interaction between subcomponents, inherent flexibility to change design processes, dependence on human cognitive and social abilities. Considering all these characteristics, we concluded that the problem of ground crew scheduling matches the description given. Similar to other design science research our objective is to develop a technology-based solution to a relevant problem of personnel scheduling (Vaishnavi & Kuechler, 2007).

Hevner (2007) introduces the three design science research cycles in a design research project: the relevance cycle, the rigor cycle and the design cycle. The research process model as presented in Vaishnavi & Kuechler (2008) consists of awareness of the problem, suggestion, development, evaluation and conclusion. These steps and cycles, together with the design science research checklist (Vaishnavi & Kuechler, 2007) were used as a guideline to develop the artefact.

Our main research question, that we have sought to answer, was:

- how can the addition of ABM components to a DES airport ground crew model be used to improve the model in terms of adaptability and comprehensibility?

3.2 Modelling and Simulation

A part of the IT artefact development phase was the development of a simulation model for validation and optimization of heuristic scheduling algorithms. According to Borshchev (2013), three different types of simulation methods can be applied to a given problem, based on the abstraction level of the model. System dynamics (SD) (Forrester, 1961; Sterman, 2000), discrete event simulation (DES) (Stewart, 2004), or Agent based modelling (ABM) (Gilbert, 2007) can be used to map the real world problem to the model.

Most of the simulation solutions for ground crew scheduling at the airport are based on DES method. Although this approach has historically had a significant success in scheduling process optimization, the addition of ABM based components can add more flexibility to a simulation model. Using ABM, we can model the movement of individual crewmembers (as agents) who can make their own decisions about the performance of the tasks assigned to them according to a predefined set of rules. Most of real events are much easier to model using agents; therefore, the model is more realistic and flexible than the DES model. Nevertheless, both models enable monitoring of resource utilization and other important statistics. According to Siebers, Macal, Garnett, Buxton & Pidd (2010), ABM is a better choice for dynamic process modelling since descriptive models of decision making processes can be included in the model, whereas DES models are more appropriate for the normative approach. Although ABM can be considerably more difficult to develop than SD and DES models, it allows the spatial or geospatial aspect to be included in the behaviour of an individual agent.

3.3 Proposed research design

In our research, we combined the design science research project with the simulation modelling approach. At the beginning of the research, the identification of opportunities and problems in the actual ground crew scheduling environment took place. Afterwards, the criteria were set to enable evaluation of the efficiency of the proposed artefact. Semi structured interviews were conducted with scheduling experts for each service group with the goal of identifying the tasks and scheduling criteria.

In this paper, the second major iteration of the relevance cycle is presented. Outputs from the experimental and field-testing were used to improve the artefact. In the rigor cycle an exhaustive literature and related work study in the knowledge base was conducted to ensure the presented solution is not only a routine design based on the application of known design process and artefacts. Since the combination of DES and ABM has not been previously used to solve the ground crew scheduling problem, our contribution can be seen as an improvement. In the final phase, our artefact came in a form of an instantiation.

In the following section, we present the development of our artefact. Following the steps proposed by Vaishnavi & Kuechler (2008), the problem is defined and the model suggestions are given. The model is then developed and evaluated with proper conclusions given. In the phase of development, simulation modelling techniques were used to achieve the given goals.

4 The problem definition

The aim of this step is to generate problem awareness. The modelled airport is a regional hub located in the southeast Europe with over 30.000 flights and over 1.400.000 passengers per year. The airport has a single 3300 m long runway equipped with CAT III/B Instrument Landing System, a 23 m wide taxiway, and 25 independent parking positions. Airport's Aerodrome Reference Code (International Civil Aviation Organization) is 4E. The terminal capacity is 500 passengers per hour, with 13 check-in counters and 2 baggage claim conveyors. The total area of the airport is 320 hectares.

The airport was selected for the design research project due to similar size and organization to other regional airports (e.g. Salzburg WA Mozart airport) and the established R&D relationship with the faculty.

Ground crew scheduling problem at the considered airport and therefore also the operation of the simulation model is confined with the arrival and departure of the aircraft, i.e. tasks can only be performed on aircraft, present at the airport. The tasks are performed in a predefined time sequence according to several criteria (aircraft size, carrier, etc.). The execution times specified by the airport scheduling experts are deterministic, i.e. fixed, making the model deterministic as well. The execution times are determined from experience and represent the maximum expected task duration.

Until the proposed IT artefact based solution was introduced, management at the airport used spreadsheets to manually generate schedules based on their knowledge and prior experiences. Ad-hoc solutions and schedule changes due to frequent disruptions of the aircraft timetable (arrivals and departures) required a lot of effort and were too slow to allow a timely but optimal response. In addition, the workforce requirements in peak and off-peak times were not properly addressed and have been only partially solved with the employment of part time workers (students).

Interviews with manual scheduling experts, e.g. crew managers, were conducted to extract the decision criteria and heuristic rules for scheduling. All the criteria identified were stored in the Flight Information System (FIS), enabling a smooth transition to the algorithm based scheduling. The identified scheduling criteria were as follows:

- Type of stopover (arrival or departure),
- Flight type (charter, scheduled or transfer),
- Aircraft type (320, CRJ, SH3 etc.),
- Carrier (9 carriers are currently using the airport),
- Destination.

4.1 Ground crew operations

The scheduling criteria presented in previous section were used to define tasks which have to be performed for the arriving and departing aircraft. The tasks of the ground crew are performed by crewmembers with appropriate skills. An individual crewmember can have one or more skill groups defined. Each skill group incorporates several different tasks therefore; crewmembers in this skill group are able to perform all the given tasks in their skill group. Some tasks are simple and can be performed by almost any skill group (e.g. luggage handling), while others require specific knowledge or other skills and can therefore be performed only by certain skill groups. With the workforce requirements calculated, shifts have to be defined. Several rules are given to define a start time and the duration of the shift: maximum and minimum duration, allowed start times, number of shifts an employee can be scheduled to during one workday. The availability and schedule of resources used also have to be defined. During one shift, each skill group performs only one type of a task. In general, tasks are divided into three main groups: a) aircraft supply, b) passenger service and c) technical service.

Figures 1 and 2 describe the process of passenger service (fixed tasks are not included) for the arrival and departure of a scheduled passenger flight (aircraft of type S, e.g. Canadair CRJ 200 LR). The passenger service department included six different operational tasks, which were mapped to skill groups with the same name, listed in Figure 1. Most of the skill groups required two persons to be assigned to the skill group. The two exceptions are the skill groups lost luggage referee at the arrival and Sales desk referee at the departure, where according to the requirements; two workers should be assigned to the task. The required number of individual workers in specific task group is

not shown in the graphical presentation. As it can be seen from Figure 1 and 2, most of the tasks overlap and must be performed simultaneously. The tasks that require a strict sequence are the tasks of guidance and transfer in Figure 2, which cannot be started before the check-in task is finished. The sales desk in this particular case is opened three hours prior to the departure of the aircraft and stays opened one hour after the departure.

The arrival services are mostly completed long before the departure of an aircraft, however they affect the availability of ground crew groups and equipment.

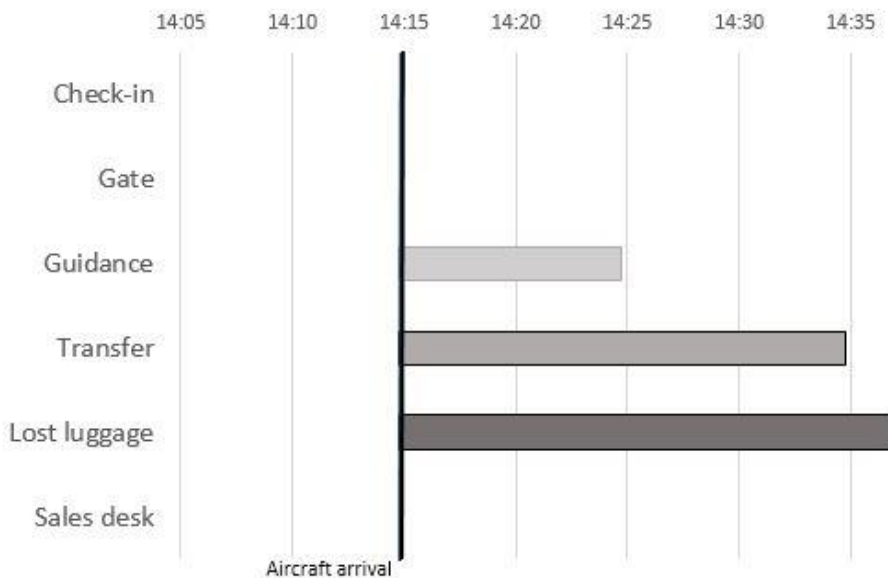


Figure 1: The process of passenger service for the arrival of type S aircraft

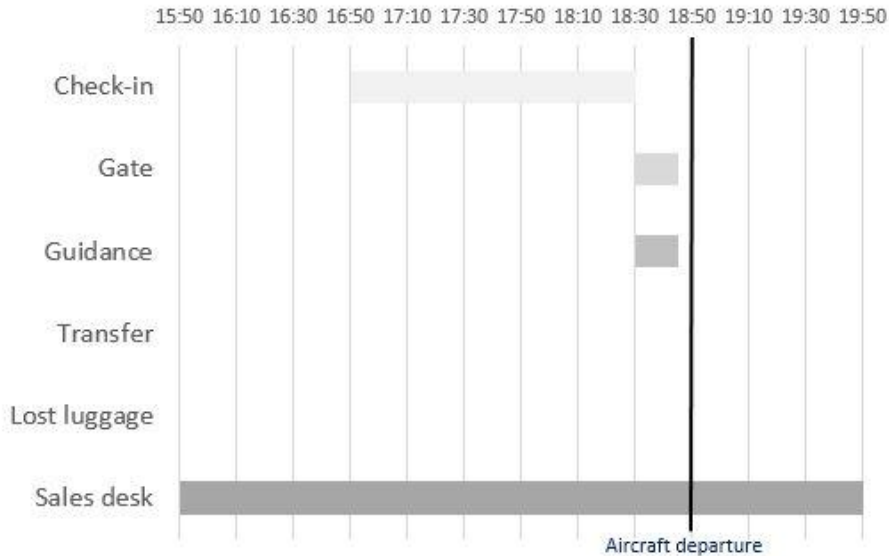


Figure 2: The process of passenger service for the departure of type S aircraft

Our work in the relevance cycle has so far resulted in two versions of heuristic workforce requirement scheduling algorithms and a shift construction algorithm. The algorithm for generation of floating shifts and assignment of individuals to shifts is described in (authors, source anonymized). The shifts are generated according to the generated workforce requirements and shift length demands. In order to automate the validation of algorithm-generated schedules and shorten the algorithm tuning-verification cycle we have developed a simulation model of airport operations used, which combines DES and ABM. The model development is described in the following chapters.

5 Selection of modelling methodology

Different simulation methodologies can be used in airport scheduling. While the most frequently used (especially in the case of passenger flow) discrete event simulation (DES) has been used to simulate airport situations for decades, agent based modelling (ABM) has only recently gained attention of the researches in the area of airport scheduling. According to Piera Eroles, Ramos & Fernandez Robayna (2009), DES has proved to be efficient in the case of airport ground crew scheduling problem. ABM has been used in various cases, from optimization of the air transportation system (Bouarfa, Blom & Curran, 2016), to airport capacity prediction (Peng, Wei, Junqing & Bin, 2014). Due to efficient usage of DES and ABM combination in other personnel scheduling domains, we can expect that the combination of both methods can also add significant value in the case of airport ground crew scheduling. While the DES methodology is efficient to represent the flow of agents and diverse resources in the case of airport ground crew scheduling, ABM components allow us to model the activities and the communications

between crew groups, their supervisors and aircraft management in detail. Using this methodology, we can lower the level of abstraction and enable a comprehensive insight on the ground crew problem, making it clear and presentation friendly when presenting it to the airport management. In addition to the advantages of the DES, where the resource utilization and time agent spends for individual activities can be addressed and optimized, the ABM allows the spatial insight on agents with detailed ground movements and estimation of time needed for the movements from one site to another.

According to Clausen (2011), ground crew tasks can be divided into passenger-related tasks and aircraft-related tasks, where the latter include maintenance, cargo, baggage, loading, cleaning, catering, towing and operations. While some personnel scheduling problems are not constrained with the availability of equipment, ground crew uses several different types of equipment within their tasks. In addition, skills of personnel have to be considered. Only few tasks performed by ground scheduling crew are plain, with no sequences and dependencies defined. Several overlapping tasks have been identified, while other tasks are interconnected. Due to these attributes, the ground crew scheduling problem gains complexity, number of constraints and variations of schedules. Mathematical models used to resolve the personnel scheduling problem in advanced scheduling tools could be used at the level of individual work group, but due to interconnectivity of tasks and resources in a case of ground crew, other techniques need to be employed (Qi et al., 2004). Since high level scheduling solutions can be too costly for small airports, many of them still use solutions which combine manual scheduling with basic spreadsheets or similar basic tools.

6 Model development

Since most general-purpose modelling tools are limited to a single methodology (SD, ABM, DES), the combination of DES and ABM methodologies within a system model generally required the utilization and integration of several general-purpose modelling tools or the development of proprietary code for the implementation of the ABM model. However, the AnyLogic tool (<http://www.anylogic.com>) allows the use of all three simulation methods, and from version 7 it also enables the usage of agents in DES and ABM model, allowing easier combinations of both methods to be implemented in one simulation model.

Borshchev (2013) emphasizes the possibility of a DES servers and entities to be implemented as agents and use of agents to introduce inter-component messaging into the model. The latter approach is used in the presented case. DES and ABM models are linked via passing a message between aircraft and work group agents, where aircraft traffic model is presented as a DES model and ground crew work model is presented as ABM model.

6.1 Model data

The simulation model generates arrivals and departures of aircraft based on the flight schedule data transferred from the FIS (Flight Information System of the airport) into internal Anylogic database. Table 1 shows an example of parameters stored in the database, assembled from the FIS. DD1 defines the date of the flight, FLTNO_A and FLTNO_D describe the aircraft's arrival and departure code. The type of traffic (e.g. C – charter passenger only, F – scheduled cargo/mail, S – scheduled passenger) is defined in column TRFTYP, ST_A and ST_D show the time of arrival or departure, and ROUTE_A and ROUTE_D designate the arrival or departure airport, and ACTYP defines the type of aircraft.

Table 1: Flight schedule stored in database

DD1	FLTNO_ A	FLTNO_ D	TRFTY P	ST_A	ST_D	ROUTE_ A	ROUTE_ D	ACTY P
01.05.201 6		JP648	S		00:20:0 0		IST	735
01.05.201 6	JP299		S	02:40:0 0		CPH-BCN		320
01.05.201 6	FAH6972	6972	F	06:25:0 0		VIE		F27
01.05.201 6		JP376	S		06:45:0 0		BRU	CRJ
01.05.201 6	JP649		S	06:50:0 0		IST		735
01.05.201 6		JP102	S		06:50:0 0		MUC	CRJ
01.05.201 6		JP938	S		07:00:0 0		WAW	CRJ
01.05.201 6	JP687		S	07:05:0 0		IST		735

6.2 Aircraft traffic simulation model

The level of abstraction and autonomy has to be identified prior to the development of the simulation model. According to available data, we have identified the DES as the most appropriate method to model the aircraft traffic simulation model. For the purpose of personnel scheduling, only arrivals and departments of the flights are important in our simulation model. Further on, the model was upgraded to the ABM elements where the movement of an element on the surface is easier to implement.

The arrivals and departures constitute of several discrete tasks that involve ground crew members. Delay elements are used to model a simple delay in the process. In our case, the delay elements include the state of arrival or departure services depending on the

ABM of ground services. Services for an individual flight are completed when all the tasks performed by the ground crew are finished. To make the model more transparent, a physical layout of the airport was used and paths of the aircrafts were added to the model. Due to focus on workgroup tasks and client specifications, taxiing and parking logistics were not modelled and are excluded from the model statistics.

The aircraft traffic model consists of two submodels: the Arrivals submodel, and the Departures submodel. The separation was a logical sequence of the airport business rules and inability to track individual aircraft in FIS after the arrival. The arrivals submodel uses the arrival schedule from the FIS to generate the aircrafts. Aircraft taxi to the gates (moveToParkA and queueArr) already waits on the apron for an assignment. The submodel of arrivals ends with an element of parking or exit point from the system. While the model of departures assumes the aircraft is present at the airport and available to start the tasks when needed.

The departure tasks start times are based on the departure times given in the FIS schedule. The modelled departure times depend on the execution of tasks and should not be delayed when scheduling constraints are defined properly. In the Departures submodel an aircraft first has to move to the gates (elements moveToParkD, queueDept and moveToGates), where it is serviced (e.g. boarded by passengers, loaded with baggage, etc.), with the delay modelled with ServiceDept element. Afterwards, the aircraft moves to the runway (moveToD, TakeOff). The queues were modelled to enable the simulation of an aircraft waiting until a taxiway or a gate or a parking area is available. The FIS data is gathered in the elements arrivals and depts., linked to a local database with arrival and departure schedule and service requirements for each flight. The service requirements are assigned to every aircraft at the moment of its entry in the model according to the ideal heuristic requirements, where the availability of workforce is not an issue. The service task parameters are contained in the messages generated by aircraft agents and sent to the relevant ground crew work group agents. Work group agents maintain an internal queue of tasks, which are executed according to the FIFO (first-in first-out) rule and specified service start time. Since AnyLogic models all DES entities as agents, the addition of the message feature to the DES aircraft traffic model was straightforward.

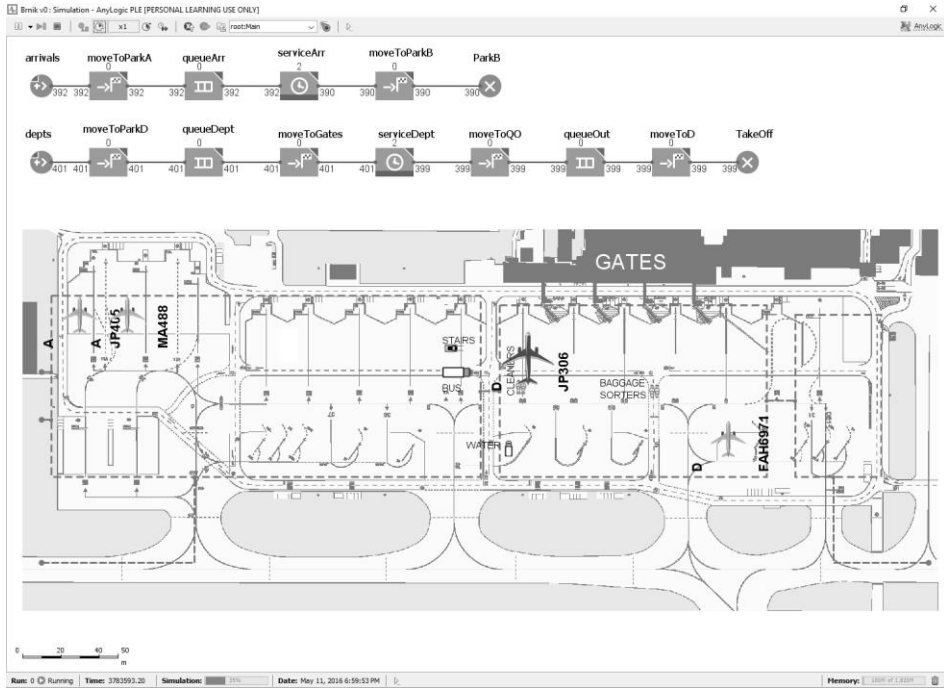


Figure 3: Main view of the simulation model with DES model of aircraft traffic and airport layout

6.3 Ground crew model

Due to relatively rigid process modelling in DES methodology, which hinder the modelling of dynamic aspects of ground crew operation, the decision was made to incorporate ABM to allow dynamic ground crew process modelling, while preserving the required level of abstraction. ABM has allowed us to model the dynamic aspects of ground crew operations with better analogies with the actual processes, making the model more comprehensible. ABM allows us to model the entities and processes in a way that is closer to reality, i.e. the ground service work groups have the role of service stations, however they travel to the aircraft and not vice versa; the sequence of services depends on the availability of service work groups, and the place of an aircraft within a service work groups' internal queue; and perhaps most important, an aircraft can be serviced by several work groups simultaneously.

Each work group agent has an internal state chart model of its task process, as shown in Figure 4. The initial state is Waiting, and here the agent waits for a service request message from an aircraft, with service requirements specifications (i.e. number of personnel, desired start of service, desired end of service). These requests are added to the internal queue and processed according to the FIFO rule. If an agent is in the Waiting

state (i.e. free), a request is queued, and model time equals the specified service start time, the work group agent moves to the aircraft, and begins the requested service, and performs until specified end time. After the servicing is complete, the work group agent sends a message to the aircraft and proceeds to the next aircraft in its internal queue or returns to the waiting area.

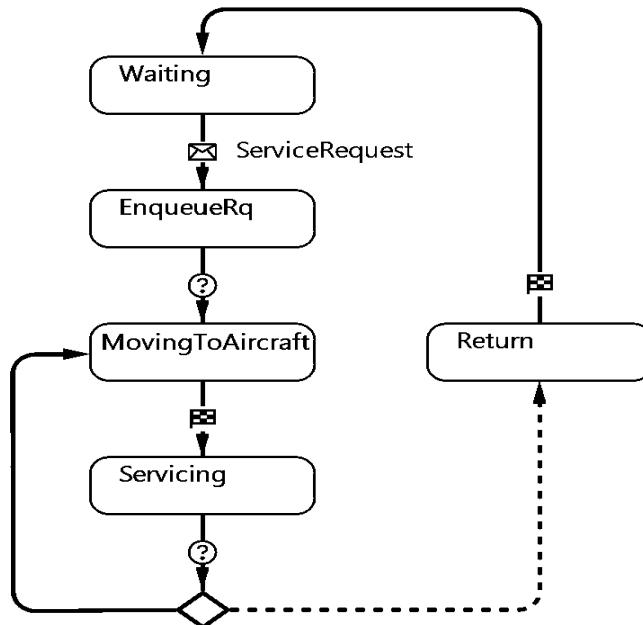


Figure 4: State chart of the ABM of a ground crew group

7 Evaluation

The FIS serves as a database for the ground crew scheduling, providing an accurate source of data about arrivals and departures at the airport. The start, end and work requirements of tasks, which have to be performed at an aircraft, are determined by the attributes of the aircraft to be serviced. The availability of workers is determined by the workforce requirements schedule. The schedule is generated and optimized by the heuristic algorithm. By combining the schedule of optimized workforce numbers and ideal requirements of a flight, we can verify the effects of a generated workforce requirements schedule in practice and foresee the potential flight delay costs.

Workforce requirements generated by the heuristic method described are used to vary the availability of workers during the simulation run. Workers are modelled as resources and arranged into work groups. Each work group performs only one type of task. A work group is then modelled as an agent.

Flight delays in the simulation results are mainly caused by the occupancy of personnel with other tasks (current priority rules are defined as a FIFO service system). Therefore, the discrepancy between ideal and modelled workforce requirements exists. Delays in the presented model are calculated for departures. Delays are measured by comparing the scheduled departure time as recorded in the FIS, and the departure time as recorded by the simulation model. The modelled delays are however exaggerated because the start times of tasks are not yet optimised and the start of a task is delayed unless all required workers are available. Further development of the model will include the execution of tasks with a reduced number of workers and longer execution time and the execution of tasks at earliest opportunity (i.e. time shifting of tasks) and should model flight delays more accurately.

8 Conclusion

Although managing disruptions of airport ground processes is a complex task (Kuster & Jannach, 2006), suitable personnel and equipment scheduling solutions are vital for efficient operation of an airport as a system. International airports face a constant challenge to coordinate all the departments, efficiently perform all operations needed and provide an excellent service to the passengers. Airport ground crew scheduling system does not have a straightforward or mathematical solution which could easily be implemented. The complexity of the problem and the necessity to solve it is not only an attribute of large airports. In our research, no appropriate solution or algorithm to solve the ground crew scheduling problem in a small international airport was found. Therefore a research was conducted to develop and evaluate an artefact to solve the ground crew scheduling problem in a small international airport.

Two versions of heuristics were developed in this artefact to implement an efficient scheduling algorithm. The algorithm for generation of floating shifts and assignment of individuals to shifts is described in previous publication (Rodič & Baggia, 2013). Further, on, a simulation model was built to verify the proposed algorithm and enable further optimization of the processes. The simulation model presented used two simulation methodologies, DES and ABM. This combination provides us with an efficient and realistic model, which is used to simulate the results of the developed scheduling algorithm. According to the design science research checklist, all questions were answered during the presented phases.

We were able to answer our main research question “How can the addition of ABM components to a DES airport ground crew model be used to improve the model in terms of adaptability and comprehensibility?”: using a suitable tool (i.e. Anylogic), we can combine the ABM and DES methodologies within a single model. Since ABM modelling requires more effort and produces a more complex model, it should be limited to the modelling of system elements, that are by nature dynamic and cannot be suitable modelled using DES methodology. Such an approach improves model comprehensibility

by more accurately modelling the behaviour of system elements with autonomous, dynamic behaviour, such as ground crew groups.

Limitations of our research stem from the specifics of the airport processes, which are mostly dependent on its size. Therefore the developed approach and artefact can be reliably expected to be applicable only to airports of similar size. Furthermore, the execution times specified by the airport experts are deterministic, i.e. fixed, making the model deterministic as well. The development of a stochastic model would require lengthy recording of actual task execution times and matching with appropriate distribution function. The airport management has decided not to implement such a survey as of this time.

Our future work on the research will involve model-based optimization of work-force requirements as outlined in the previous section and the adaptation of the entire scheduling solution to the airport's development of infrastructure.

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Understanding New Emerging Technologies Through Hermeneutics. An Example from mHealth

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Abstract New technologies such as mHealth have entered the health domain as an innovative technology to connect people suffering from a chronic disease with healthcare services to reduce the pressure on healthcare systems. The primary driver for these technologies is data and they contain valuable information. Understanding what the data means and the accuracy of the data can be complex. Hermeneutics has been applied in previous Information Systems studies that interpret data to provide a meaning about unexplored and complex phenomenon. This paper provides background information about Hermeneutics and an example of Hermeneutics applied in a new mHealth study.

Keywords: • mHealth • Hermeneutics • Qualitative Study • Information Transformation • Emerging Technologies •

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1 Introduction

The Information Technology innovation continuum is creating new and innovative solutions for different industries. Particularly, the healthcare industry is witnessing a new era of innovation (Spanakis et al., 2016) as new emerging technologies such as Mobile Health (mHealth), is being adopted to assist in fighting and managing diseases at both global and individual levels to deliver better health management platforms (Willcox et al., 2015). The technology is delivering innovative solutions through mobile devices that facilitate a number of initiatives that include but not limited to health call centres, treatment compliance, appointment reminders, mobile telemedicine, and patient monitoring (World Health Organization, 2011). These innovative solutions can empower people and patients to be proactive in managing their health through self-management (Guifeng et al., 2015), as self-management can prove critical in reducing healthcare costs while delivering optimal healthcare services (Monsen, Handler, Le, & Riemer, 2014). The empowerment of patients to self-manage is through the delivery of information that allow them to understand their medical conditions (Hayes & Aspray, 2010) and it is through the devices, as the devices act as a gateway for accessing healthcare services through the exchange of data and information. The exchange of data is through secure data transfer mechanisms between patients and healthcare professionals. The data contains valuable information and it is primary driver for the treatment of diseases and empower of individuals to self-manage their health.

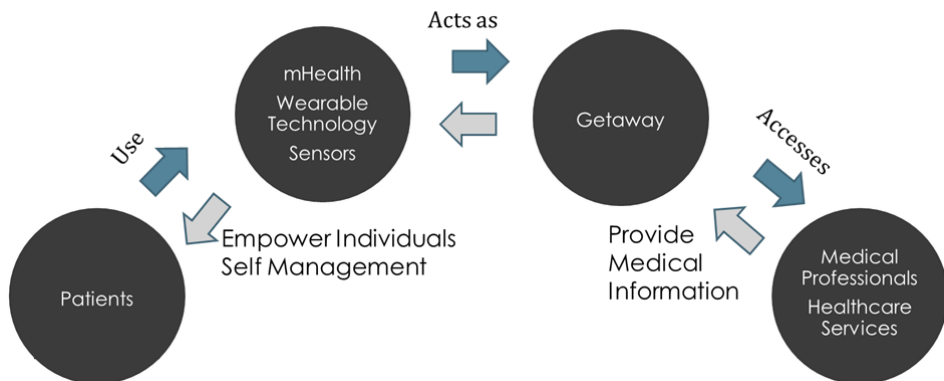


Figure 1: Example of how technologies are becoming a gateway for patients accessing healthcare services

While new technologies are introduced and solutions have been created, how does one interpret the data captured by such devices to learn more about the underlying IT solution that facilitates the transaction between the different stakeholders of an IT healthcare solution? More specifically, from a research perspective, how does accessing secondary data produced by the devices allow the researchers to understand if the technology is delivering the desired outcome? While from the healthcare point of view, how does one evaluate the quality of a solution and whether it is delivering accurate healthcare services?

The technologies are new to the health domain and require a well-established research method to understand how they operate, specifically the IT solution that is delivering healthcare services to people and patients. Although today's modern data analytics platforms are extracting new insights from such technologies to create business value and answer some of the business questions (Tailor, 2015), yet from a scientific perspective it can be challenging. A way to approach the analysis of secondary data from new, emerging technologies can be accomplished through Hermeneutics. Hermeneutics has long been applied in studies where the texts/artefacts are distant from its original authors. The application of Hermeneutics in new emerging technologies is to gain a window through interpretation, into the phenomena lived by the patients interacting with healthcare professionals for the management of diseases while using any of the technologies. The essence of interpretation in such cases, is to understand how the technology is operating, the quality of the primary driver of the technology being data, and the integrity of the information based on the data.

The purpose of this study is to understand what data accuracy is, discover the sources of data inaccuracy in health data and the impact inaccurate data has on the Integrity of the Information while determining the most appropriate Machine Learning Algorithm that can detect inaccurate data. The accuracy of the data is understood through Interpretation and it is done through Hermeneutics and Thematic Analysis.

2 Literature Review

This section of the paper introduces Hermeneutics with a background around Hermeneutics in the Information Systems (IS) domain and an example from a current research in progress where Hermeneutics is used for analysing secondary data based on an mHealth solution for diabetes.

2.1 Hermeneutics

The term Hermeneutics is a modified transliteration of the Greek verb "hermeneuein", a term that means to express aloud, to explain or interpret and to translate as explained by Kennedy Schmidt (2014) and it is a technique derived from the Interpretive Paradigm (Grbich, 2013). It is also known as the process for making a meaning (Esterberg, 2002). Hermeneutics was thought to have originated as the study of the interpretation of the Bible (Lee & Dennis, 2012) and has been applied in the interpretation of previous work of authors who studied the Bible (Black, 2006).

Historically, in ancient Greek, it was believed that Hermes, the mythological messenger god was equipped with language and understanding that enabled him to interpret the messages from the gods and deliver them to the mortals (Butler, 1998). This mythological example illustrates the process for interpreting messages and communicating them with people. The four key terms of language, understanding, interpretation and communication, from the example, are key to Hermeneutics.

In research, the researcher must be equipped with the language of the subject understudy, understand the messages (data, texts, artefacts), has a method to interpret the texts to effectively communicate the results from the study to the audiences. Although equipped with language and understanding, the interpretation can become an issue. When interpretation becomes an issue, it is an issue of unintelligibility and it occurs when a person does not understand an artefact that he or she came across, and it is known as rebelling against successive smooth understanding (Tkáčik, 2016). In research, unintelligibility can occur when the researcher accesses secondary artefacts that are distant from their original authors and has no access to the language that would enable an understanding of the artefacts.

The objective of using Hermeneutics in research is to interpret texts that would allow an understanding of phenomena, peoples' actions and behaviour to address questions that fall under the interpretive paradigm. IS research can be classified as interpretive if it is assumed that our knowledge of reality is gained only through social constructions such as language, consciousness, shared meanings, documents, tools, and other artefacts (Klein & Myers, 1999). Interpreting texts through Hermeneutics is not an easy task and requires an in-depth understanding of Hermeneutics and the interpretation process.

The problem with interpretation is that it is a two-fold problem. The first problem is avoiding projecting one's own viewpoint on the text (Coelho, 2001) and blur the interpretation of the texts as one's preconceived ideas may influence the interpretation. The second problem is the need to successfully communicate to a variety of audiences (Coelho, 2001). However, ones' own perceptions and experiences in a subjective, cultural, and historical, as referred to as the lifeworld, can be included in the interpretation of the texts (Høiseth & Keitsch, 2015).

In the IS domain, Hermeneutics has had a dominant role in the interpretation of Information Technology (IT)/IS related studies and the results are quite interesting as they provide a fresh view of the IT systems. The widely-known paper of Klein & Myers (1999) set out principles in conducting Hermeneutics in IS, Robert, Wendy and Lucas (2001) for Hermeneutics and meaning making in IS, Boydens and van Hooland (2011) using Hermeneutics in quality of empirical databases and Acker (2015) toward a Hermeneutics of data, are a few examples where Hermeneutics is key ingredient to the study. They all seek to make meaning of the study and providing guidance in finding a meaning to the study (See Table 1).

Table 1: Summary of papers where Hermeneutics was applied in the study

Paper	Summary	Author(s)
A SET OF PRINCIPLES FOR CONDUCTING AND EVALUATING INTERPRETIVE FIELD STUDIES IN INFORMATION SYSTEMS	Use of Hermeneutics to make sense of failed IT implementation	Klein & Myers, 1999
HERMENEUTICS AND MEANING -MAKING IN INFORMATION SYSTEMS	Introducing IS Researchers to Hermeneutics, and the concept of Interpretation	Robert, Wendy, & Lucas
HERMENEUTICS APPLIED TO THE QUALITY OF EMPIRICAL DATABASES	Present a conceptual framework to analyse and improve the quality of empirical databases to interpret shifts in the quality of databases	Boydens & van Hooland, 2011
TOWARD A HERMENEUTICS OF DATA	Using Hermeneutics to analyse the traces of data left in a networked computing infrastructures	Acker, 2015

Hermeneutics can help render the meaningful of a text (object or phenomenon), which has become obscured or ‘distanced’ in some way, thereby making it no longer immediately obvious (Robert, Wendy, & Lucas, 2011). An obvious everyday example that does not interpretation is a STOP sign as it is either understood or not (Kennedy Schmidt, 2014).

When is Hermeneutics needed? Hermeneutics can provide a rich, detailed interpretation of peoples’ experience and texts (Grbich, 2013). Traces of data and metadata left in a network computing infrastructure are becoming computing history where Hermeneutics is needed to provide an interpretation of the data (Acker, 2015). Interpretive research can help IS researchers understand human thoughts and actions in social and organizational contexts; it has the potential to produce deep insights into IS phenomena including managing of IS and IS development (Klein & Myers, 1999). Hermeneutics was also discussed in the development of Information Engineering (Fonseca & Martin, 2005) due to its powerful ability in interpreting users and the system.

With new emerging technologies, human actions can be understood through the interpretation of data produced by the devices as they are used by people and patients for specific needs, specifically in healthcare. The data is becoming an extension of people and patients as traces of interaction between patients and medical professionals are

captured and exchanged to achieve a desired state of well-being. Yet, while the data has served its purpose, it contains valuable information that can help in different scenarios. From the technological side of the solution, it sheds light on how the technology functions, how the underlying data quality help achieve the desired health outcome and what exactly does the data contain that enables this transaction.

While mHealth being a new technology where prototype solutions have been developed and commercially available, studies in the actual quality of data is not looked at thoroughly as the technology is still in its early stages. The following section will elaborate on how Hermeneutics is applied to study the emerging technology of mHealth with specific focus on Data Quality.

2.2 Hermeneutics in a Case Study Research of mHealth

The preceding section has defined Hermeneutics and its application in IS studies. This section illustrates with an example, the process of applying Hermeneutics in the study of a new emerging technology used for health and disease management. The illustrated example in this paper is from a current research study. The objective of conducting the study is to evaluate data accuracy and information integrity in mHealth solutions, identify how data inaccuracy can occur, test different Machine Learning Algorithms, and evaluate the accuracy of the algorithms in detecting inaccurate data.

The selected case study is mHealth for diabetes with the case being patients' data. The selection of the case study was based on the research question, in which it posed as following:

‘How can Machine Learning be applied in mHealth Solutions to Address Data Accuracy and Information Integrity?’

The research question aligns with the study objectives as it is broken into sections. Starting by which type of Machine Learning, how it can be applied in mHealth, what defines Data Accuracy and Information Integrity. The selection of the case study was based on the research question, as it is one that conforms to Yin's (2014) criteria for selecting case study, as the form of question is ‘How’, requires no control of behavioural events and focuses on contemporary events. With using case study, the data is secondary, de-identified data of people with diabetes and there was no control of behaviour when the data was produced and it presented a contemporary event. The two sources of data present both structured and unstructured cases of data. The first dataset is of patients with diabetes who have glucose measured through both a device and recorded on paper. The second dataset is extracted from hospital admission records where diabetes was either a factor in admission or was recorded during the admission. These two datasets assist in addressing the research question by using the interpretive paradigm as it allows for the reconstruction of understanding of the social world (Denzin & Lincoln, 2000). Both

datasets allow a rich experience in exploring how different diabetes data is collected and for what purpose, with the patients' experience captured during both scenario.

The Hermeneutics method used in this study is adapted from Kim (2013) using the 3 layers consisting of Text, Translation and Interpretation layer (See Figure 2). The 3 layers separate the text into layers where each has its own purpose and that allow for the data to be analysed using Hermeneutics. The text layer is all the text/data in the study and it is the first layer of Hermeneutics. The text starts with the actual datasets. The datasets are reviewed to form an understanding of what the datasets contain, the format they're in and all the properties of the data including data dictionaries. Once reviewed, the data is then aligned with codes (extracted from Thematic Analysis) from the Literature review that cover Data Quality (each element of Data Quality, source of Data Inaccuracy), Information Integrity and Machine Learning. To simulate the process of disease management for patients with diabetes, the data is mapped against the Omaha Client Care Plan that segments the data into Problem Classification Scheme, Intervention Scheme and Problem Rating Scale for Outcomes. The simulation helps in understanding the role of each instance of data in disease management. After the data is examined and mapped against Omaha System, the data is then divided into training and testing data, and that is to test different Machine Learning Algorithms. These parts form the text layer as they are mainly text and are yet to bring a meaning that would assist in addressing the research question. The text is translated using Thematic analysis.

The second layer is the Translation Layer where Thematic Analysis is applied to generate themes that can extract meaning from the text. The Thematic analysis is adapted from Braun and Clarke (2006). Boyatzis (1998) explains Thematic Analysis as a process for encoding qualitative information. The text in this study is secondary data, one where there's no access to the patients or the medical professionals and they are open for research. The state of the data does not have a meaning and is therefore stateless data. To understand what the text is, Thematic analysis look for patterns in information that at minimum describe and organize possible observations while at maximum interpret aspect of the phenomenon (Boyatzis, 1998).

The interpretation of the data occurs at the third layer of Kim's (2013) model. The Interpretation Layer is interpreting the themes to form an understanding about the phenomenon. The interpretation method is adapted from Taylor, Francis, and Hegney (2013), and it starts with turning to the nature of the lived experiences, that is accessing people who would tell about the phenomenon understudy. The lived experience comes from investigating the experience as it has been lived rather than conceptualizing it by accessing data or people who have an experience related to the research question, that is real and has occurred.

Combining the three layers with the Thematic and Hermeneutics analysis is to divide the sections with clear and concise objectives that would allow for Hermeneutics technique

to be implemented correctly in the right flow. That is by understanding at what stage occurs the text, the translation and the interpretation of the data.

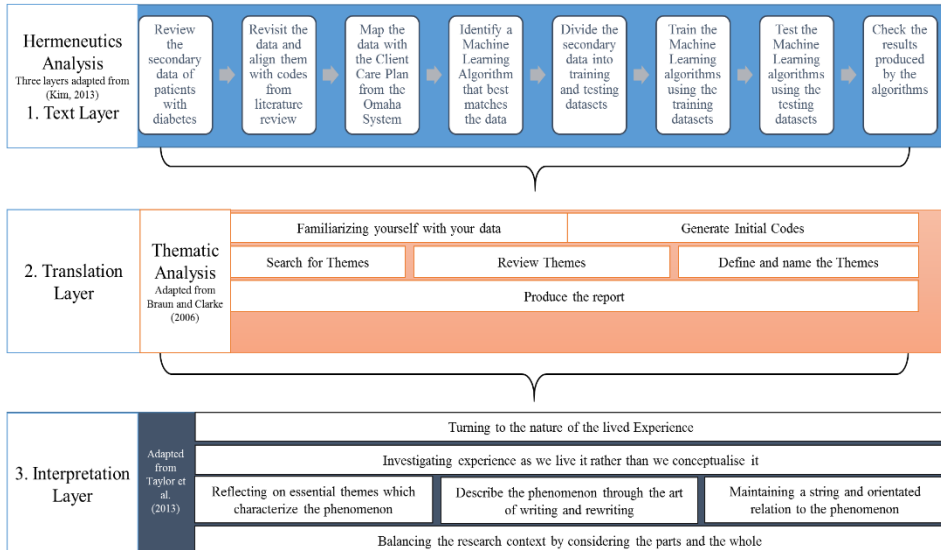


Figure 2: Hermeneutics in studying new emerging technologies

3 Findings

The purpose of Hermeneutics is to derive understanding from the text under study as explained by Phyl & Carol (2006). The adoption of Hermeneutics in this research has moved the study from analysing electronic data to understanding the meaning of accuracy and how it occurs in a technology based solution such as mHealth. The data was first measured and evaluated against a set of criteria derived from the definitions of Data Quality that were based on World Health Organization (WHO) data quality standards and definitions of Information Integrity from the literature review.

To date, the study has found that accuracy occurs at multiple levels with each instance of accuracy intended for specific use (See Figure 3). The first level of accuracy occurs at the validation layer where data is simply validated as either accurate or inaccurate based on the input. The model of this validation measures the input against type of data (text, integer, float, date) and whether they fit the range. This form of validation ensure that the data passes its basic test of meeting the minimum level of accuracy before it is passed on to the next level of validation. This made the Classification Algorithm an appropriate Machine Learning Algorithm that could be applied to filter through the data and test the validity of the data before it is processed. Modern electronic forms apply a simple ‘rule based validation’ where data is tested at the time it is entered and no learning is taken into consideration when the next set of data is entered. Machine Learning powerful capability

of learning and predicting data makes it a more suitable technique that would enhance the data quality at the very basic level.

The second level of data accuracy examines the properties of the data. Although the data might have passed its first instance of validation, yet the properties might still not be appropriate for its intended purpose such as timely medical reminders, currency and completeness of readings of a patient or symptoms. Achieving this level of accuracy can be accomplished through the Prediction Algorithm that can predict future datasets based on the existing and historical data. This allows for the current values to be cross-examined against what the algorithm have predicted and raise an alert if major discrepancies in the data is detected through the algorithm.

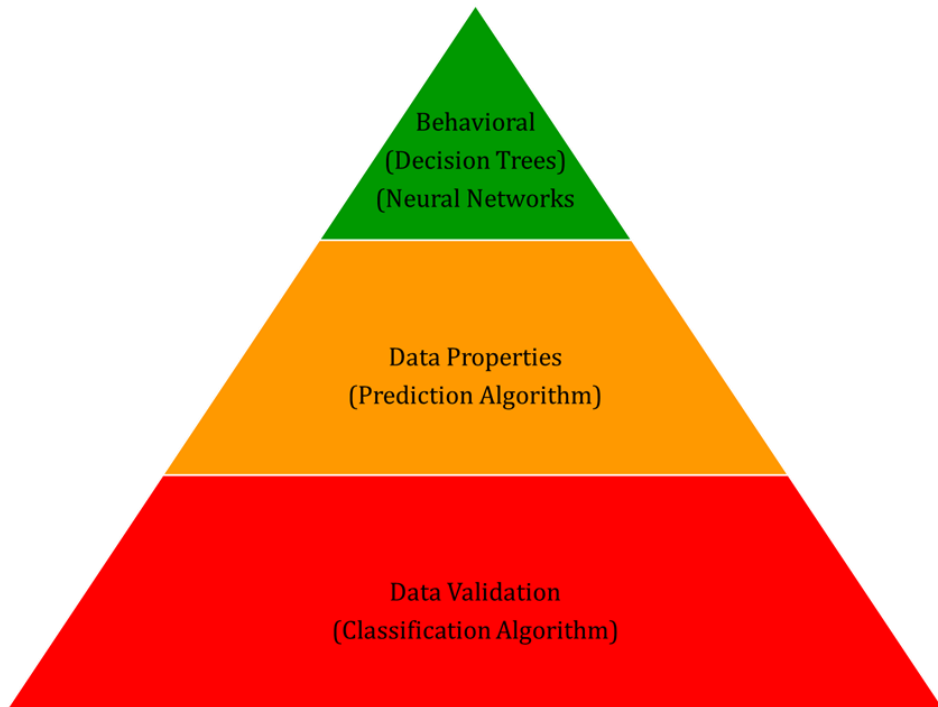


Figure 3: Levels of data accuracy in a digital health context

The third level of accuracy occurs at the behavioural level where the human behaviour, based on the data, is analysed to understand the meaningfulness or the usefulness of the data and its intended use. This includes decision based behaviour or health outcomes that can detect if a treatment is being adhered to as planned or if there's a gap in the intervention program for the specific disease. Behavioural accuracy is reflected through the decisions that are being made which can be mapped through Decision Trees or Neural Network algorithms that can simulate a person's decision making process that would

allow the medical professional to understand the thinking behind patients' decisions. This satisfies the collection of the data in an mHealth scenario and in the absence of a medical professional when the data is entered by the patients.

While still at an early stage of analysis, these findings are a result of Hermeneutics where the technique has shifted the focus from simply cross-examining the data against certain definitions, to understanding the meaning of accuracy in an mHealth context.

4 Limitations

A key drawback for this study is the datasets. The data was not obtained from an actual mHealth solution as the mHealth solutions are still in early development stages. However, the use of the algorithms against data like the ones produced by mHealth solution, particularly one designed for chronic diseases such as diabetes, make the results more appealing and relevant to technologies. The results do not only consider the accuracy of the data but highlight some key areas of where data accuracy might be influenced by behaviour of patients and users of mHealth technologies.

5 Discussion and Conclusion

Emerging technologies can hold valuable data that require beyond traditional analytics platforms for the analysis of data from a scientific perspective. Hermeneutics has had a role in previous IS studies and has provide to provide a fresh perspective of IS systems. The new technologies are changing the way patients seek advice from medical professionals, manage their disease, and delivering healthcare services through the platform. This change can have many undiscovered, unexplored phenomenon attached to the technologies that are yet to be studied. The role of Hermeneutics in this study is to assist in the interpretation of the data through a well-designed process that extracts meaningful information from the themes generated by the data.

The study is of qualitative nature and not quantitative as it seeks to understand the data, and particularly application of Machine Learning in mHealth. To understand what the data means, and how Machine Learning can be applied, Thematic analysis and Hermeneutics provide rich and detailed coded information with techniques to extract information that provide insights about data and how information is produced.

The data is of quantitative nature and the study focuses on understanding a single instance of mhealth designed to assist in a case of chronic disease. It does not aim to statistically evaluate the instances of accurate or inaccurate datasets in a mHealth transaction but instead its objective is understanding in detail the cause of inaccurate data.

IS studies have become richer in information, and Hermeneutics has found its place in IS domain as an interpretive technique that seek and explore a deep, powerful meaning of a phenomena. The mHealth technology is capturing peoples' actions and health

information that is becoming an extension of them that requires a technique, like Hermeneutics, to be applied to understand the underlining messages hidden in the data. Similar future studies may incorporate mixed methods approach to strengthen the findings through triangulation of methods that would provide two different perspectives on data.

6 Future Research Directions

This research sets the foundation for examining the quality of health data in digital context. There are several areas that will require research to be done to continue delivering high quality healthcare services through mHealth technologies. One key area is the human behaviour when using the technology, especially when entering and transmitting the data. Whilst the human behaviour is understood, another key area is the accuracy of other mHealth technologies when used for the treatment or management of other diseases.

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Designing and Implementing Common Market for Cross-Game Purchases between Mobile Games

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JANI YLI-KANTOLA & JARI JÄRVINEN

Abstract The mobile game markets are increasingly competitive and the game publishers are looking for new ways to increase player retention and cross commercialization of games. In this paper, we examine how a purchasing system using virtual currency based common market can be designed and implemented in order to create a larger service platform. The solution enables cross-game purchasing of virtual items from one game into another. We present how such a system can be designed, how it would fit into larger vision of multi-game ecosystem and what kind of limitations there are when implementing such a system. As a result, we describe solution of a bank and a marketplace entity, which are responsible of the transactions, virtual items and connecting games to each other. As a conclusion, we are presenting the expected challenges and expansion plans for the common market system.

Keywords: • Mobile games • virtual currency • common market • cross-game purchase •

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1 Introduction

Mobile games have become a booming branch of gaming industry over the past years. This is mainly due to new smartphones with better displays, faster internet connections, much higher computing power than before and easy and powerful app delivery platforms with monetization abilities. Globally, in 2016, mobile game industry brings in revenue of \$36.9 billion yearly, and is expected to grow to \$47.4 billion by 2018 (newzoo.com). As the number of games increases, so does the competition to get visibility and share of the players' interests, and on the other hand to keep the players to play the game they have started once.

Keeping players engaged in the mobile game is referred to as player retention. In particular, in the free-to-play mobile games, player retention is important to the game's business model. Free-to-play games are freely available to the player, but they typically contain mechanisms that include in-app purchasing in the game, where virtual currency can be bought with real money. Such purchases offered to players are usually virtual items that bring benefits, modifications or personalizations to the game world. Other ways games monetize on their players are for instance selling advertisements; players watch ads in order to proceed or gain advances in the game. Getting the player to spend money one way or the other is vital to the free-to-play games, and in order to retain the players, new ways to get them to returning to the game are needed. Games developed or published by the same gaming house are looking for ways, beyond traditional advertising, to get the player to stay inside their gaming business. At the same time, game industry aims to grow beyond the boundaries of the industry to other fields of entertainment.

At the same time, cryptocurrencies, virtual currencies, loyalty programs, etc. are reaching new areas of digital business. The traditional view of economy is being splintered and new ways of payment and currencies are coming every year. Loyalty programs are front-runners in a trend where ability to spend points is extending rapidly and the loyalty points are more and more becoming a currency in traditional sense. Cryptocurrencies like Bitcoin approach this from another direction where the currency is well controlled by rules, but the places where to spend the cryptocurrency are still limited. (Iwamura et al., 2014) Spending is often done by first exchanging the cryptocurrency to more traditional vehicle of credit like euros or dollars and then are spent especially in cases where anonymity of the transaction is not crucial. Cheah (2015) point out that Bitcoin and other cryptocurrencies often behave as an asset and not like a currency as it is subject to lots of speculative actions and the value is changing rapidly. This upheaval in economy and influx of new currencies are affecting the gaming industry as well where games are usually considered as islands where in-game economy is affected only by game mechanics and influx of resources created by players buying virtual items and purchasing power with traditional currencies.

In this research, we investigate the possibilities to design a common market for cross-game purchases that can be used in several free-to-play mobile games. The motivation

for this is to have stronger gamer cross-pollination between games and to cross-promote and advertise other games in better targeted ways for players. Using the common market platform the players could also buy virtual items to other games, creating more interest for them to stay within the boundaries of the common market.

The designed common market would connect the games on game mechanic level through the cross-game purchasing and subsequently creating an exchange rate between game currencies. Instead of using in-game currencies only in one game economy, the target is to expand this thinking to link game economies loosely together. To clarify the scope of the research there is no single currency in games and the designed platform does not allow virtual currencies to be exchanged directly. It means that for instance, ‘gems’ in Game X cannot be exchanged to ‘gold’ in Game Z. However, what the platform would allow to do is to spend ‘gems’ in Game X to purchase virtual items in Game Z. The publisher of Game Z in this situation dictates the selection what is available to be bought. The common market approach does not have to stop only to games, but there will be also a possibility to add non-game items to the common market. For example, coupons to web stores etc. could be bought in-game as well.

Our research question are 1) how the cross-game purchasing between mobile games could be designed and implemented and 2) what kind of limitations can be identified regarding game economies, game design and implementation? In our research, we study single-player games that are free to play mobile games, but our findings may extend further.

In Chapter 2 we introduce the related research on how virtual currencies and game economies have been studied. In Chapter 3 the methodology for the research is delineated and the use case for the single market cross-game purchasing is described in more detail. In Chapter 4 the implementation of the system is described and in Chapter 5 the findings based on the design concept are discussed. Finally, in Chapter 6 we offer conclusion of the study.

2 Related Research

No comparable system for cross-game purchasing between mobile games has been found in our investigation of the pre-existing systems. Therefore, we have studied game economy and virtual currencies, as both are important part of the creation of the common market.

Lehdonvirta (2009) categorises virtual currencies as a subset of virtual goods. Virtual goods are goods, which can be mass-produced and are often bought and sold in virtual environments such as massively multiplayer online roleplaying game (MMORPG). Other examples of virtual goods are items and characters. Lehdonvirta notes that very often the virtual currencies in MMORPGs can be traded back into real currencies if wanted, which creates bi-directional connection for the currencies.

Yamaguchi (2004) notes that traditional economics do not consider in-game currencies as real, but in his research the virtual currencies in games do have enough same characteristics than government-issued currencies, so in-game currencies may be considered as real currencies at least in some games. For example, no one is going to buy a Monopoly hotel with a real money, but may buy a virtual item in a MMORPG. Thus, an exchange rate is formed between virtual game currency and traditional money (Yamaguchi 2004).

Sasson (2015) has studied free-to-play mobile games and noted how the most successful ones have two currencies used in the same game. He names these currency concepts as a hard currency, which is more closely related to the real money the players are using to the game and soft currency, which is more virtual currency. Soft currency is what players earn in the game by playing it and hard currency needs to be bought with real money or the player needs to earn it somehow which is not directly linked to game flow. If only one currency is used, it limits the user's spending abilities as monetisation of the game requires the single currency to be hard to obtain and players may not be able to continue without spending real money into the game. Balancing game economy is important as source of currencies need to be in line with the ability to spend the currency. Both soft and hard currency needs to be of value to the user. Sasson (2015) shows that if the currencies are a bit scarce when comparing to the players' want to continue, the player is more likely to buy some aid to the game with real money.

Cryptocurrencies have entered the mainstream of currencies after the launch of Bitcoin in 2009. They have no physical manifestation, but work only in digital environment. From the cryptocurrencies, especially the Bitcoin has gathered trust around it to make it a currency, which can be used in many places. It excels in use cases of anonymous digital transactions where traditional currencies are heavily tracked and have slow and cumbersome processes to transfer money from person A to person B. Bitcoin and other cryptocurrencies - altcoins - are based on the Blockchain technology which is a public distributed ledger with a mechanism for arriving to consensus between all nodes. Cryptocurrencies are very flexible to design and configure. Due to the flexibility, there has been several implementations for different use cases but very few has gathered enough popularity around it to make it as a workable currency. (Bonneau et al 2015)

Sharp and Sharp (1997) define loyalty programs as structured marketing efforts which reward and therefore encourage loyalty behaviour. One trend in loyalty programs is to expand the industries participating in the loyalty program. This is especially true in airline industry. This adds value for the customer and make program more attractive to join. Loyalty programs are inherently virtual currencies with restricted abilities to use them. Buchinger et al. (2014) studied four different cases of virtual currencies in loyalty programs and defined how they are different in terms of what they are achieving.

Generating and spending currencies are two pillars of the currency behaviour. For example, Bitcoins are created by "mining" them which means performing difficult

mathematical puzzles to ensure the transaction coherence in the system. In loyalty schemes, the company creates from thin air the currency, which is promised some value in the loyalty scheme network. The value might change and perhaps the currency has an expiration date. Cryptocurrencies are indestructible in a sense that the “coin” does not leave the system. In transaction, the ownership is changed. In loyalty schemes, the value of the credit is nullified after the purchase, as it has no intrinsic value.

Bitcoin and other cryptocurrencies have brought an interesting discussion about the fundamentals of currencies themselves. Mallard et al. (2014) argue that the Bitcoin has a distributed currency model without any issuing organisation. There is only an original ruleset, which has been updated along the evolution of the Bitcoin. The trust is based on the rules and if everything is running normally there is no party, which can change the rules on their own. Traditional currencies like euros and US dollars have a centralized organisation which is responsible of the issuing the currency. Due to history, the ability to issue currency is detached from the daily politicians and central banks have been created. Central banks are deemed the trustworthy organisations, which should behave predictably and not be intimidated by politics and quick gains.

3 Research Method and Context

The aim of this study was to design an implementable solution for cross-game purchasing that would make possible to use earned currency in one game to buy virtual items in another game. The possibilities for earning currency was either to play certain games, or import exercise data from wearable sensors (that would be turned into the currency). No matter how the currency was earned, it could be used to make purchases in other games belonging to the system. The additional goal of the currency was that it could be used to gain discounts for purchases made in selected web stores or brick-and-mortar stores.

This aim was deemed specific to the needs of the project companies and it was anticipated that the solution for the virtual currency system would have to be tailor-made to the companies in the project. The existing virtual currency systems reviewed above were not seen fitting to the purpose. Therefore, we adopted case study research methodology (see Yin, 2014). Case studies are commonly used in software engineering field to study practical phenomenon in a real life context (Runeson & Höst, 2009). Here, research needs were first to understand the requirements of the multi-game virtual currency system, and then design a working system to purchase virtual items between games and interaction with real life contexts. In later stage, the system will be tested in the real life context.

Due to the complex nature of the studied system, this research presents first the vision of the planned cross-game purchasing. The real world complexity determines the limitations of the study, where we first present the created vision of the cross-game purchasing before considering the real-life use. In our study, we also consider the challenges of building such system in real-life, and therefore the trade-offs that can be anticipated at this stage of the study.

The selected case under investigation in hailing form a research project, where companies identified the need for the multi-game currency with options to collect and use it also in real world. The case study comprises of two gaming companies. Fingersoft has made and produced mobile games since 2012, and has several games out at the moment. These games are free-to-play games, and the company has approximately 100 million Monthly Active Users globally. Fitness Village is a new gaming company, focused on developing their first game that targets gamification of exercise, including exercise related virtual game play, and exercise data imported from wearable exercise sensors.

In the centre of interest of the participating companies is to design and implement an entire service platform, which imports real world exercises from sensors, and exports the data to selected mobile games as virtual currency, through conversion rate. This currency could be used to buy virtual items from other games. This exercise data part of the research is not studied in this paper, only what happens after the exercise has been changed to an in-game currency. On the other hand, most free-to-play game also have their own internal point or currency systems as the enabler for in app purchases. This currency works in isolation within the game and is often too specific to the game logic in question, to be transferred to other games as such. Meaning, that some type of point or currency conversion is needed for cross-game purchases, as well.

The overall vision is to have a so-called common market for cross-game purchasing that combines all the elements together and allows expansion by adding new games and web stores or retailers to the system. Ultimately, this would enable the creation of a functional and powerful digital ecosystem on the top of the technical solution. For the companies in the digital ecosystem, this will give excellent opportunities to monetize their business in various ways. Starting from the existing means in mobile games industry (in-app-purchasing, targeted advertisements, user acquisition, cross-promotion between different games and applications), to also giving an unique selling points for businesses in other domains to market their services and products for the mobile gamers and exercise oriented customers. It is envisioned that this way the players will be more engaged to stay in the gaming ecosystem, since they receive tangible rewards from the time and effort they use on playing and thus improving the game retention. A vision of the common marketplace with virtual currency earning use possibilities is shown in Figure 1.



Figure 1: Common market service platform vision for the virtual currency (own illustration)

It is understood that the realization of the full service platform and virtual system would require a type of banking solution that would keep track of transactions in a secure way. Yet the companies aim not to build too heavy and complicated system that would not allow scalability and would be too complex to maintain. Next, the first working design to be build is constructed and the next steps and foreseen challenges elaborated on.

4 Results

The implemented case presented in this paper is only the first part of the research to design and implement the above presented vision as a whole. Although there are two selected games in this case that are part of the interconnected system, the design is still done by taking account that it could serve several games in future and the games can be different kinds of free-to-play mobile games. One selected game is an established game (Game A from Fingersoft) and the other is a game (Game B from Fitness Village) is to be released during year 2017. Both games do have their own currency systems, but there

is a possibility to buy in-game products from another game by using a currency from that game. In this case the possibility to buy virtual items is unidirectional where products in Game A can be bought from Game B. Implementation does not yet cover the buying the products to other direction because in the more established game the user interface part is not yet able to provide this.

Both games have dual-currency model similar to what Sasson (2015) described. The currency used to buy virtual products from another game is a “hard currency” which is more difficult to obtain than the “soft currency” making the virtual product more valuable and rare. The publisher of the Game A uses the marketplace platform to put products available for purchase and prices them in the currency, which is used in the Game A. The marketplace has an exchange rate table, which tells how much Game B currency is worth in Game A currency. This exchange rate is determined when new games or entities are entered to the system. Concurrently, other limitations are determined like from which games can the virtual item be bought, how many of the items can be bought in certain amount of time or how much of currency can be used for this. For example, no more than two times per day can the purchases be made per player. The single virtual item can have its limitations as well. For example, one item may be bought five times or just one time. In the Figure 2 is described the high-level architecture of the common market.

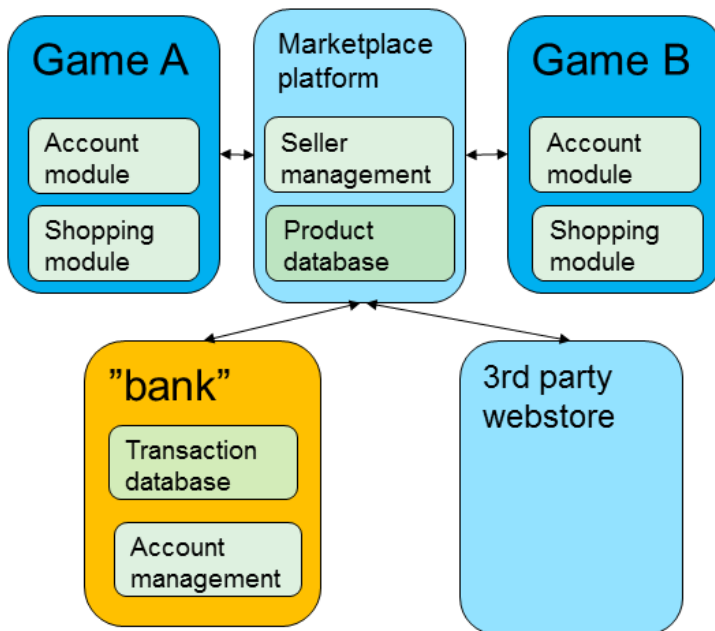


Figure 2: High-level architecture of common market platform (own illustration)

In the centre is the combination of marketplace and bank. Marketplace is responsible for keeping count of virtual items that are available for purchase and which of the items has been sold to which player. Sellers can add, edit or remove the items or check how their items have been sold. The marketplace will offer the list of purchasable virtual items for the games.

Bank is responsible for the transactions between the games and keeps track what assets are located where and how they are being paid. In addition, the bank has abilities to roll back the transactions if the customer is unhappy and demands his resources back or some technical error has occurred and the purchase did not succeed perfectly. The bank accounts do not store value. They only exist to track the transferred resources and receipt is created from it. The value is afterwards nullified. The reason for this is that the philosophical approach of the bank is not to mimic a traditional bank but provide platform for assets to be exchanged between the games. Both games are benefitting from the exchange from other means than keeping the in-game resources of the other game, thus the in-game resource may be nullified after use.

The similarity to a real bank extends to the reliability and robustness of the system. The system needs to be able to detect in vast majority of cases if the transaction was complete and the virtual product bought was actually delivered. In some cases the delivery may be delayed due to problems in networks or servers but in our case the limit for delivery is 24 hours and if the product has not been delivered during that time, it is reimbursed for the customer.

When designing the bank entity there was a design choice to be made on how to implement the bank entity and the transactions. In this implementation, the bank is controlled by one actor (in this case a game publisher), but one choice could have been to create more independent platform by utilising blockchain technology which would offer higher scalability and possibly more trustworthiness for other game publishers to join the common market as well. In the end, the closed and controlled system was decided to be the implementation as that is more in line with the business plan.

Marketplace platform is for game publisher and third party web stores to control what they have available to be sold in games. For example Game A publisher can put “pink running shoes” for sale and value it at in Game A currency, for example in ‘gems’. The item may have some in-game abilities or be just aesthetical upgrade. Visibilities to different demographics and games has been under discussion, but not yet implemented. In Figure 3, a mock-up of what kind of functionality the platform has for the publisher is shown.

Login: Publisher A ID:34902190 Item list Preferences

Item name (64 char)

Item type

Price Game

Start date End date

hr min hr min

Item description (1024 char)

Item URI

Item icon
150px x 150px
(click to upload)

OK/Ready/Commit

Figure 3. Mock-up of how to add virtual items to marketplace (own illustration)

In games, there is a shopping module, which is common for all games that are implementing the common market for cross-game purchasing. When player navigates to the in-game shop, the game asks for a web page, which is created and populated in the marketplace but the visual style can be set by Cascading Style Sheet (CSS) in the game. A default page without modifications can be used as well, but how games are showing the list and how it is navigated to can be up to the game in question.

When an item has been bought for a game from another game, it is checked and deployed when game is launched and then user is informed that the item has arrived and it references the other game as a source. The product is deployed only once, after that it is the responsibility of the game to track.

Identity management in the common market is important as it should not encourage sharing resources between players but it should encourage one player to play multiple of games. How the identity is shared between games and how they are linked through the bank entity has multiple possible solutions and it has to be taken account how the chosen solution affects the user experience and privacy. The platform does not need to know who the user is but it needs to know that the player playing Game A and Game B is the same person. The reason for this is that even if it would be valuable to know who the player really is, it cannot be a requirement. It is identity provider's responsibility to know who the player really is.

Apple and Google are dominating the mobile game distribution by their AppStore and Google Play -markets. Both are taking their cut from the purchases made in games by

real traditional money. The companies are closely guarding their share of the profits. The cross-game purchasing needs to be created in a way that it conforms to the rules set of Apple and Google. Especially this needs to be in line in cases where the games and identities are ranging from one ecosystem to another. In cross-game purchasing there is no money moving between games and the virtual items available must be exclusive for the common market.

5 Discussion

According to our research, the common market for cross-game purchasing is a novel solution for higher player retention and advertisement of other games. For players the advertisement part is more subtle than state-of-the art advertisement videos we see now in mobile games. For them the cross-game purchasing is offering value as they are getting something out of it. Implementation is now only between two games and it is likely that the concept would need more games to make impact and be more meaningful for the players. However, as a proof-of-concept it shows that the concept can be implemented and it has some merit. For future research is left the analysis of the impact and how the players are reacting to this concept.

Some potential issues have been identified during the design of the common market. First of all the cross-game purchase might affect the game balance in unhealthy way if the items bought from another game are disrupting the player path. This balancing of purchasable items is noted also in Oh and Ruy's (2007) research for Korean games. For example buying too powerful item too early in the game might derail the whole game and take out the feel of accomplishment from the player. Aesthetic-only items without game effect are easier to add from the game design point of view, but they might leave a subset of players uninterested about the purchase. Implementing the cross-game purchase to a game needs to be part of the game design and designers should weigh what they want from it and how it might affect the game.

Another point is the effect of the cross-game purchase to the game where the buying was initiated. When a player is pondering whether he or she should use resources in Game A to purchase something to Game B, the player faces a dilemma where he or she needs to think, if the resources used would help more in Game A than in Game B. Making the player to compare the games and the willingness of progressing in either of the games might lead to feel-bad moments, which should be avoided. Hard-earned currency in Game A is valuable for the player and squandering it to a wrong item might hurt the player desire to play the game further. This dilemma of putting the games against each other in terms of resource usage needs to be researched in future more thoroughly to see how it should be solved in more elegant and user friendly way.

Another point for discussion and further research is the data ownership in games. The currency earned by a player in one game and used in another can be tricky from data authorization point of view in cases where Games A and B are developed by companies

that are not in a formal business relationship. Since the currency in game A is owned by the player (not the company which developed the Game A) the marketplace platform is required to request access to the currency from the player him or herself. Only after player has granted access to his or her Game A currency, it can be utilized in game B by the same player via the marketplace platform. It is anticipated that this dilemma can be solved using a standard OAUTH mechanism, but this will be in the scope for further implementations of the system.

6 Conclusions

In this research, we studied a novel concept of how common market for cross-game purchasing could be designed and implemented. State-of-the-art mobile games have dual currency system, which provide us the possibility to build on top of that. Any kind of connection between different mobile games is not in mainstream today. In our research, the connection is based on ability to buy virtual items from other games by using in-game currency. The motivation for this to game publishers is to increase player retention in games and use the system to advertise other games. Incentive for the player to take part of this instead of watching periodic advertisement videos he or she gets value by installing new games and playing more.

The implementation connects two games and makes it possible to do cross-game purchases to one direction. In future, the connection should be bidirectional and possibly new games are added. The cross-game purchasing needs a marketplace entity and a bank entity. The marketplace entity will manage the items available in games and provide UI for sellers and buyers to interact with the system. The bank entity's responsibility is to monitor how resources are moving between games and additionally it has the right and the ability to roll back faulty purchases. There are open questions on how the players like the functionality to buy items from other games or even discount coupons from web stores. In Chapter 5 we brought up some open issues and future research directions, which we have encountered during this work.

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Diabetes Lifestyle (e)Coaching 50 Weeks Follow Up; Technology Acceptance & e-Relationships

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Abstract We report on the 50 weeks follow up results from a healthy lifestyle pilot (High Intensity Nutrition, Training & coaching), conducted with 11 insulin-dependent Type 2 Diabetes Mellitus (DM2) patients. Hybrid eHealth support was given, with electronic support plus a multi-disciplinary health support team.

Regarding the pilot goal of long term healthy lifestyle adoption in senior DM2 patients, challenges were: low ICT- and health literacy. This exploratory design analysis formulates design lessons based on 50 weeks follow up.

The first 12 weeks contained intensive face-to-face and eSupported coaching. After that, patient self-management and eTools were key. After 50 weeks, attractiveness and feasibility of the intervention were perceived as high: recommendation 9,5 out of 10 and satisfaction 9,6 out of 10. TAM (Technology Acceptance Model) surveys showed high usefulness and feasibility.

Acceptance and health behaviours were reinforced by the prolonged health results: Aerobic and strength capacity levels were improved at 50 weeks, plus Health Related Quality of Life (and biometric benefits and medication reductions, reported elsewhere).

We draw three types of conclusions. First, patients' health literacy and quality of life improved strongly, which both supported healthy behaviours, even after 50 weeks. Second, regarding eHealth theory, iterative growth cycles are beneficial for long term adoption and e-relationships. Third, a design analysis was conducted regarding long term service mix efficacy in relation to key requirements for designing ICT-enabled lifestyle interventions. Several suggestions for long term lifestyle eSupport are given.

Keywords: • Type 2 Diabetes (DM2) • eHealth • Lifestyle • Monitoring •
Coaching • Blended Care • Service Design •

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1 Introduction

Our Western lifestyle plays a large role in the onset and progression of DM2: type 2 Diabetes Mellitus (Lim 2011). Several lifestyle interventions improved outcomes in type 2 diabetes patients on insulin therapy, most notably: lower blood sugar and lower medication needs (Jenkins 2008; Esposito 2009). However, these are often costly, highly controlled interventions. Moreover, the longer term (> 6 months) sustainability of behaviour changes is limited.

The question is: can we do this on a more ‘Do-It-Yourself’ and e-Supported basis? This would have two advantages. First, since behaviour improvements are implemented within patients’ lives, it improves the chances of sustained health behaviour (Simons 2013). Second, it is cheaper. Since 2010 the Health Coach Program has been used to improve lifestyle and metabolic outcomes (including reduced insulin needs for type 2 diabetes (DM2) patients), via eSupport, improved self-management and rapidly improved health behaviours (Simons 2010, Simons 2015).

To promote rapid health results, a HINTc (High Intensity Nutrition, Training & coaching) intervention of 12 weeks was developed for this patient population, plus lightweight eSupport and mostly self-management in weeks 13 - 50. The intervention combines improving health literacy with active behaviour change support.

This paper discusses follow up results and design lessons after 50 weeks, as part of a larger biomedical study. An important goal of the biomedical pilot study was to promote long term (> 6 months) healthy lifestyle adoption in senior DM2 patients. Even in well-facilitated settings, a majority of interventions lack sustained health effects after 6 months (Verweij 2011). Moreover, in eHealth initiatives, there is always the risk of falling victim to the ‘eHealth law of attrition’ (Eysenbach 2005): meaning that 90% of users are often already lost within a few usage instances.

In this study population, there were additional challenges due to their low average ICT- and health literacy. This exploratory design analysis formulates design lessons based on 50 weeks follow up. We focus on feasibility and attractiveness of the HINTc e-supported lifestyle intervention, plus on formulating design lessons. Given the desire to develop cost-effective long term eHealth support relationships with these types of patient groups, a focus is on long term e-relationship support lessons. Medical results will be discussed in another paper.

Research Questions:

- What are the 50-weeks-follow-up feasibility and attractiveness of the HINTc e-supported lifestyle coaching program; and what are the effects on quality of life?
- What design lessons emerge for long term eHealth and e-relationship support?

As part of the design analysis we address: efficacy of the service mix deployed in eSupported lifestyle interventions. We combine the 50-week results from our measurements with a design analysis based on an evaluation framework of requirements for ICT-enabled healthy lifestyle interventions.

2 Theory

The eSupported lifestyle program combines coach sessions with electronic dashboarding and self-management. Hybrid programs (face-to-face plus tele-support) have been indicated to be attractive for some time (Demark-Wahnefried 2007, 2008). Finding the right mix between offline and online contacts is an ongoing design research challenge (Pekmezi 2011). In summary, a hybrid or multi-channel service mix is recommended (De Vries 2008, Sperling 2009, Simons 2002, 2006, 2010, 2010b), combining electronic and face-to-face interactions. Still, there are many design challenges, given the multitude of options. For a more extensive discussion, see Simons (2014).

Key functionalities to increase health motivations and behaviours in this eSupported lifestyle program are (Simons 2010, 2014 and 2016):

- Daily logging of insulin and blood sugar levels: for close progress monitoring of the health coaches, physicians and participants themselves.
- Close cooperation with physicians, for rapid medication adjustments initially (avoiding dangerously low blood sugars when insulin dosage is not reduced rapidly enough in the first days), plus medical monitoring/coaching in the following weeks.
- A personal online health dashboard with graphs of progress towards adherence targets on the various health behaviours;
- Automated feedback on lifestyle aspects where positive scores have been achieved (nutrition, physical activity, stress management or an overall score);
- (Tele)coaching by a health coach, generating online reports on progress towards adherence targets in the personal dashboard;
- The (tele)coaching sessions can be flexibly planned, based on convenience and participant preference: during in-clinic visits or phone based from home;
- Options to ask questions to the coach: via messaging within the dashboard or via email;
- Online schedule indicating upcoming events: group sessions, individual coach sessions (when and where), physical measurements, surveys;
- A micro-learning Health Quiz accessible via smartphone, mail and/or web;
- Reading materials in the mail;
- Weekly tips via email on health, motivation and self-management;
- Besides individual coaching, group sessions are also used in order to stimulate group support, mutual inspiration and encouragement, plus peer education.

It was theorized and tested elsewhere that the design challenge of persuasive technology (Fogg 2002, 2009) for health is not just located in the ICT design, but also in the design of the overall service scape, including health effects and coach relationship (Starr 2008, Simons 2014b). It should generate positive, mutually reinforcing service experiences across communication channels and activate long term health motivation and -behaviours, in order to deliver long term health results. This is reflected in the following design evaluation framework for health improvement ICT solutions (Simons 2014), see Figure 1.

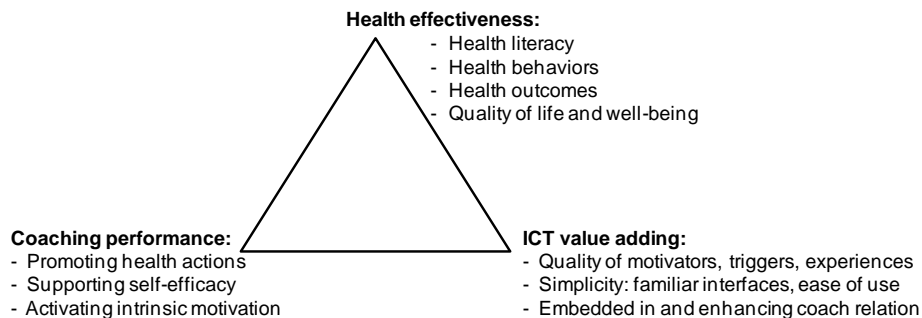


Figure 1: Basic requirements when designing ICT-supported healthy lifestyle interventions

Figure 1 addresses three evaluation domains: health effectiveness, coaching performance and ICT value adding. It helps evaluate the impact of ICT-enabled interventions and will be used as analysis framework for section 4, Results.

3 Methods, Study Design, Intervention

This is a non-randomized, one arm, pilot intervention study of 12 weeks Sept-Nov 2015, plus effect measurement at 50 weeks follow up; approved by the Leiden University Medical Center (LUMC) Ethics Board. The biomedical results will be addressed in a separate paper. The study participants were 11 insulin-dependent Diabetes Mellitus Type-2 patients. Patients were volunteers and provided written informed consent prior to the study. They were recruited by LUMC from the larger Leiden area in the Netherlands. They were 8 men and 3 women, ages 39-70 years, with widely varying levels of education (although skewed towards the lower end) and of comorbidity.

Challenges regarding design of individual training schedules were posed by all the physical constraints in this group: 7 had significant movement restraints (knee- and hip-replacements, cardiovascular blood flow constraints, stents), 5 had neuropathy, and 7 had cardiovascular disease. On average they had been a Type 2 Diabetes (DM2) patient for more than 10 years and they were motivated for trying lifestyle improvements.

TAM surveys (Technology Acceptance Model, Venkatesh 2000) were used at weeks 4 and 12 to assess intervention feasibility and attractiveness. In this study, TAM is only used qualitatively, as a tool for user evaluation, not to make technology acceptance calculations or predictions. For this purpose, its eight dependent variables provided us with ample user evaluation insights, compared to the four dependent variables of UTAUT (Venkatesh 2003).

Furthermore, user satisfaction evaluations were user plus the RAND SF-8 Health Related Quality of Life survey (Ware 1998). Besides, a standardised sit/stand test is used to assess strength (Csuka 1985) and an Astrand test (1976) for endurance.

Study inclusion criteria

- Type 2 diabetes mellitus treated by insulin therapy with or without oral blood glucose lowering drugs.
- BMI \geq 25 kg/m²
- Age 30-80 yrs
- Dutch language and basic computer competence (for use of email and web based dashboard)

Exclusion criteria

- Recent (< 3 months) myocardial infarction
- Uncontrolled blood pressure (SBP > 170 mmHg and/or DBP > 100 mmHg, 2 out of 3 measurements)
- Any chronic disease other than type 2 diabetes hampering participation (at the discretion of the investigator)
- Low motivation to participate (score 2 ‘weak’ or 1 ‘very weak’ on a 5-point scale).
- Alcohol consumption of more than 28 units per week at present or in the past
- Psychiatric disease (as defined by DSM-V)
- Claustrophobia
- Metal implants or other contraindications for MRI

The eSupported lifestyle intervention HINTc (High Intensity Nutrition, Training and coaching)

An extensive eSupported lifestyle program is offered, which combines coach sessions with electronic dashboarding and self-management, plus electronic health tips and a digital health quiz game. Intensive coaching is offered for 4 weeks with the purpose of generating self-propelling behaviours and capabilities. In week 1 a low-calorie approach is taken to enable rapid alleviation of fatty liver conditions. The support in weeks 5-12 is more lightweight, with group sessions at the end of weeks 6, 8 and 12, weekly electronic

tips and a digital health game. The support in weeks 13-50 is: sustained eTool support, plus 6-weekly group coach sessions for sharing and discussing each other's progress and challenges, for reinstating health literacy lessons and for social group support.

As an umbrella overarching the personalized coaching per participant, the general lifestyle advice follows the guidelines of the Harvard Epidemiology and Nutrition Group for nutrition and physical activity, with specific modifications for diabetics. The guidelines are to increase intake of vegetables and low sugar fruits (each 2,5 servings/day or more), to choose whole grains instead of refined grains, to limit sugar and other high glycaemic load foods, to have one daily serving of nuts and/or legumes, to limit intake of red meat and processed meat, to limit intake of trans and animal fats, and to have no more than 2 (male) or 1 (female) alcoholic beverages/day. Physical exercise guidelines are: at least 60 min/day moderate intensity activity (like walking or gardening) and at least 3x30 min/week intensive activity, which was also supported with group training sessions at the LUMC location three times per week (Borg level 12-14). Stress management guidelines are: relaxation exercises for >10 min/day.

4 Results

We discuss several types of results. We address answers to the first research question: What are the 50-weeks-follow-up feasibility and attractiveness of the HINTc e-supported lifestyle coaching program, including the positive feedback provided by the improvements in quality of life and physiology (insulin medication, blood sugar, physical stamina)? And to answer the second research question ('What design lessons emerge for long term eHealth and e-relationship support?'), we analyse efficacy of the service mix deployed in eSupported lifestyle interventions, following the framework of Figure 1 from Theory.

First, regarding attractiveness and feasibility, satisfaction and recommendation were not only high after 4 weeks (8,7 and 9,0 out of 10 respectively) and 12 weeks (9, 1 and 9,0 out of 10 respectively), but also after 50 weeks: 9,6 and 9,5 out of 10 respectively. This is in contrast with usual patterns where the initial enthusiasm of the first weeks wanes after 3 months. Regarding 'Health Related Quality of Life' as measured with the RAND SF-8 an interesting pattern emerged over the 50-week period, as illustrated in Figure 2.

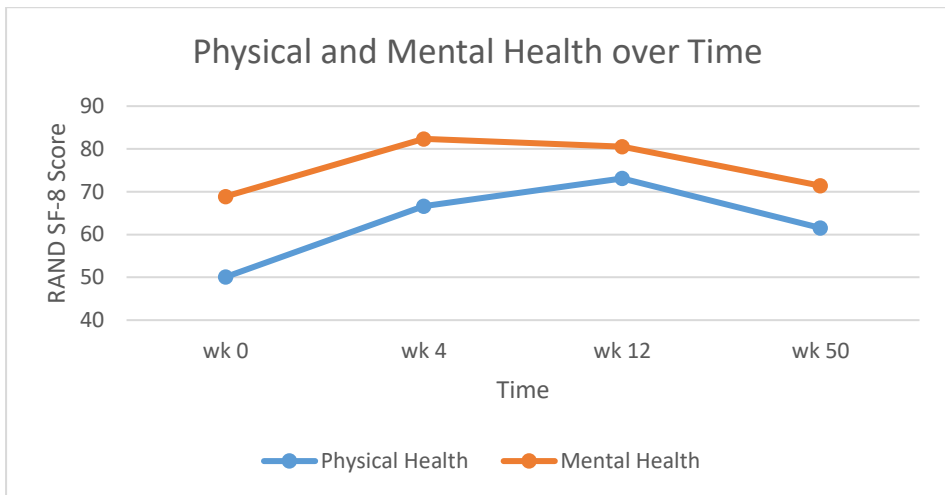


Figure 2: Physical and Mental Health (RAND SF-8) in weeks 0, 4, 12 and 50.

The Physical Health score moved from an average of 50.1 at start to 66.6 at week 4 to 73.1 at week 12, to 62 at week 50, with 76.2 as the Dutch average (Standard Deviation: 13.5). So for Physical Health, we see a steady and significant rise in the first 12 weeks (due to better eating and training), and after that a decline to 62, which is still better than the start. Mental Health went from 68.9 at start, to 82.4 at week 4, to 80.6 at week 12, to 71 at week 50, with 77.6 as the Dutch average (Standard Deviation: 13.7). Experienced Mental Health seems to peak at week 4. This coincides with the large positive surprise that the patients experience in the first 4 weeks: fast improvements in fitness, quality of life, medication, self-efficacy, health literacy, fun and group support, plus a hope for a better future. In the following period between weeks 4 and 12 there is a continued building up of strength and fitness, losing weight, building patterns/habits and gaining longer term self-efficacy. After 12 weeks, group training stops and patients are much more on their own. Patterns diverge, with some continuing to improve further, whereas others decline.

Second, some of the physiological improvements of the first 12 weeks were sustained at 50 weeks (a more detailed analysis will follow in a separate publication, based on more reliable and extensive biometric and clinical measurements): average 8% weight loss (was 9% at 12 weeks), roughly 20% lower fasting glucose and 65% lower insulin medication (was 20% lower and 71% lower respectively at 12 weeks, based on data in self-monitoring tool).

Clearly, the results in the first 12 weeks helped motivate patients and provided positive feedback that they were on the right track. Still, given the goal of long term (50 weeks)

health results, it is positive to see that the 12 week results are largely sustained through to week 50.

The two measures for physical endurance and strength showed interesting differences over time. Endurance measure VO₂max first increased + 45% at week 12 and was + 24% at week 50. Strength (measured via 30 sec sit/stand test) on the other hand was +23% over the 12-week period and further improved to +44% (week 50). Of the 11 participants, 7 have continued intensive exercise in weeks 12-50.

Third, the TAM (Technology Acceptance Model) user evaluations of week 12 and 50 shed some further light on patients' experience and appreciation of the intervention, see also Table 1.

Table 1: TAM (Technology Acceptance Model) user evaluation
 (n=11, weeks 12 and 50)

TAM Construct	Week 12 Score (out of 7)	Week 50 Score (out of 7)
1. Usefulness	All items ≥ 6.8	All items ≥ 6.6
2. Effortless	-Lowest (5.0): Health Quiz -& Lowest (5.0): Food/exercise logging in dashboard 5.3: Food guidelines	-Lowest (4.8): Food guidelines 5.1: Food/exercise logging in dashboard 5.2: Week tip in mail
3. Opinion of social circle	All items ≥ 6.3 ; except 'other patients': 5.4	All items ≥ 6.3 ; except 'other patients': 6.0
4. Support	All items ≥ 6.0	All items ≥ 6.0
5. Affect	All items ≥ 6.4	All items ≥ 6.5
6. Ability	All items ≥ 6.0	All items ≥ 5.7
7. Trust	All items ≥ 6.2	5.8: Privacy? Rest: 6.5
8. Valuation (e)Support elements 'What helped most to build health behaviours?'	6.9: Personal Trainers 6.8: Health Literacy 6.7: Daily eLog sugar/insulin 6.7: Support Health Coaches 6.6: Support Physicians 6.6: Support/advice via mail -Lowest (4.6): Homework physical exercise -2 nd Low (5.6): Health Quiz	6.7: Start menu/diet 6.6: Health Literacy, Personal Trainers, Group sessions 6.5: Support Health Coaches, Physicians 6.4: Start Workshop -Lowest (5.6): Health Quiz, Week tips, Homework physical exercise
9. Future Use Intention	6.7: Daily eLog sugar/insulin 6.6: Regular training/exercise	Only 3 items (rest not applicable): 6.6: Healthy eating

	6.6: Ask advice Health Coaches or Physicians Lowest (5.0): Food/exercise logging in dashboard All other items ≥ 6.0	6.4: Regular training/exercise 5.8: Use tips and Health Quiz to increase Health Literacy
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The TAM (Technology Acceptance Model, Likert scale 1 to 7, strongly disagree to strongly agree, with several negatively coded items) user evaluation at weeks 12 and 50 shows three main patterns. First, these patients were relatively positive at 12 weeks and 50 weeks about all TAM constructs. Aspects that scored particularly high were: usefulness and the support offered by the multidisciplinary health team.

Second, some patients were not ICT-literate and clearly had trouble with eTools like the Health Quiz of food/exercise logging. See Simons (2016) for a more extensive discussion on their differences in ICT adoption, which became apparent in the first 12 weeks.

Third, we observed that over the course of roughly weeks 12 to 50, attention of participants shifted, also visible in their TAM scores. After initial attention on tools and start up challenges, attention later shifted to health literacy, plus sustaining healthy food and exercise patterns. In hindsight (at week 50), participants started appreciating the intensive start menu and start workshop more, the exercise support continued to be highly valued, plus sustaining healthy patterns in weeks 12 to 50 was top of mind: see the high scores for these elements in TAM constructs 8 (Valuation of support elements) and 9 (Future use). On the level of social support and maintaining a healthy lifestyle focus, the group spontaneously organized monthly meetings together, outside of the hospital setting.

The final set of study results regard research question 2, analyses to enable lessons for long term eHealth relationship building. As a basis, we use an efficacy evaluation of the hybrid eSupport mix deployed, at 50 weeks follow up. Table 2 shows the authors' evaluation using the theory framework of Figure 1.

Table 2: Authors' design evaluation at 50 weeks follow up, on design requirements from Figure 1 (authors' opinions, 5-point scale from - - to ++)

Health Effectiveness	Coaching Performance	ICT Value Adding
<u>Health Literacy:</u> + Better than the low literacy start, but much forgotten at wk 50 by some. - Increased falling back into certain old beliefs at wk 50.	<u>Promoting health actions:</u> ++ (e)Coach mix promoted steps forward for all. +/- Increasing variance after 12 weeks.	<u>Motivators, triggers, experience:</u> + Most used one or more eTools in wk 12-50, but large variance.
<u>Health behaviours:</u> +/- After 12 weeks: Improved behaviour, but large variance.	<u>Supporting self-efficacy:</u> + Sustained self-efficacy at 50 weeks, except for two patients with major life/health events and low compliance wk 12-50.	<u>Simplicity:</u> ++ Simple mail reminder for sugar/insulin inputs. (Some were highly ICT-illiterate.) - Health Quiz and food logging being complex for some.
<u>Health outcomes:</u> ++ Biomarkers & medication.	<u>Activating intrinsic motivation:</u> ++ Getting results and feeling better. Continued high satisfaction at wk 50.	<u>Fit with coach processes:</u> ++ eTools: integral part of coach processes and effectiveness. +/- Much motivation support still from the coaches, less from tools.
<u>Quality of Life:</u> + At wk 50 better than start.		

Table 2 contains several lessons. First, looking at Health Effectiveness, we see mixed results. Biologically, there are large, positive effects for all 11 participants, even at 50 weeks. Even despite the large health, education and psychology differences within the group. However, regarding health literacy and self-management competence, the large differences that were observed at the start, became increasingly pronounced during the 50 weeks follow up. This relates to the second column: Coaching Performance. Promoting health actions and intrinsic motivation worked relatively well. But with those patients that have less self-management skills, it is hard to maintain coaching effectiveness in the 12 to 50 weeks period. Third, regarding ICT Value Adding, it was good that there was a variety of eTools, given the large differences in the patient group regarding ICT literacy and preferences. The simple mail based tool for sugar/insulin monitoring was highly valued by all. And for the multi-disciplinary coach team the eTools were very useful for progress monitoring and pro-active coaching. See section 5.1, design lessons and implications for practice, for further reflection and improvement ideas on eTools.

5 Design Lessons and Implications for Practice

Several lessons can be learned from this study in relation to the intensive healthy lifestyle approach and in relation to the suitability of hybrid eHealth support. Plus, we will address options for improvement.

First, it is interesting to see in this HINTc intervention that satisfaction is high initially (at 4 & 12 weeks) and stays high or even seems to grow (during at least the first 50 weeks), even though large lifestyle changes are requested from the participants. Our interpretation is that contributing factors for this satisfaction are: gains in self-efficacy and health literacy, seeing results plus feeling results, which activates intrinsic motivation. In other words: the large and growing benefits that patients experience. The benefits, besides medication reduction, are also clearly visible in the increased scores on the Physical and Mental Health dimension of the RAND SF-8 Quality of Life survey.

Second, based on qualitative feedback from the participants, it appears that several new, healthier food and exercise patterns started to become ‘the new normal’ already after 4 weeks into the intervention, remaining ‘normal’ for participants at week 12 and 50 as well.

Third, opinions varied regarding the suitability of most of the eTools provided (like the health quiz, the email week tips, food and exercise logging). In the short term of the first few weeks, virtually all tools were used by virtually all patients. After several weeks, usage patterns diverged. Two factors appeared important in determining adoption and use of these tools: availability of time, plus ICT literacy (with the latter appearing most important: four participants expressed aversion at using computers. On top of that, individual preferences are important. For example, one participant continued daily food logging for over 50 weeks (whereas all others stopped after week 12), because he liked this form of explicit monitoring. Two other participants continued using the Health Quiz throughout the 50 weeks (the rest did not). Several others continued reading week tips and other health content during the 50 weeks follow up. Clearly, user preferences for the various eSupport tools differed.

Fourth, the exception to this varied eTool adoption pattern was the simple, daily mail reminder Tool for sugar/insulin inputs, also described in Simons (2016). This tool was used daily again by the patient group in weeks 48 - 50 to assemble user pattern data. (The tool was not used in between, since care was handed over to their General Practitioners). We think that the combination of high simplicity with high usefulness was the key to its high adoption. The tool was an important basis for the coaching from the multidisciplinary support team. In conclusion: eSupport was not only useful for the patients, but especially for the care givers, providing them with much more extensive views on the users.

Fifth, besides eTool support, the group effects and the multidisciplinary support team were highly valued. The patient group arranged several social events together during the weeks 12 – 50 period and every 6 weeks there was a 1-hour gathering at the hospital again with the support team. The hospital team meeting was valued socially, but also for health literacy and practical support. These group effects fostered high levels of interpersonal commitment, which is important for long term relationships and something that is more challenging to achieve with eTools.

Finally, if we look at future improvement suggestions, several innovation opportunities emerge. First, in the coaches' professional opinion, strength and endurance improvements could have been significantly larger with more effective training. Thus, in the next diabetes lifestyle project better training equipment will be used. Second, the training progress feedback loop will be used more, with a mail based self-management monitoring tool similar to our sugar/insulin tool. So that even after completion of the group training period together, the coaches can continue monitoring and guiding patients better on their exercise progress.

Third, regarding building long term e-relationships, it would not be correct to label the phase of 12 to 50 weeks as 'maintenance'. Patients are continuously renewing their patterns, experiences and lessons. All in relation to health literacy and health competence. Better (e)Support is needed for these renewed learning processes. Within long term support relationships, there clearly are patient needs for continued learning, growth and discovery. Hence, more functionality will have to be developed to stimulate online, effective search-, interaction- and question/answer behaviours of patients. Both in relation to health literacy questions as well as in relation to health routines, goals and competencies.

6 Implications for Theory

As stated before (Simons, 2016) for several of the patients in this group, their learning styles were highly non-cognitive. An (apparent) understanding of health cause and effect seemed to have less impact than experiencing cause and effect. Daily feedback loops between behaviours and (negatively high) sugar values were useful in this regard. For this group, learning is not very much about explicit awareness, intentions, goals, behaviour and maintenance plans, as postulated in models like HAPA (Health Action Process Approach) and i-change (Schwarzer 2010, Wiedeman 2011). This appears to resemble mental models of impulse purchasing in marketing: first acting, then experiencing and opinion forming (Vohs 2007).

Next, the term 'maintenance' (as used in HAPA for example) seems a miss-qualifier for the longer term phase of health behaviours observed here (12 to 50 weeks). What we observed was closer to processes of: iterative circles, continuous renewal, re-interpretation and discovery. These processes of course include pitfalls for those who have fragile health literacy. The latter group easily tend to fall prey to misbeliefs and misadvise from others around them (patients, family of popular press). Thus, finding effective and efficient formats for continued (e)coaching is very valuable for long term support as part of long term e-relationships with patients.

Finally, four of the eleven participants simply disliked using ICT (whether laptop, smart pad or smartphone) for either reading, checking mail or inputting data. Still, the overall-attractiveness of the intervention was rated high, because of a) the large benefits and b) the extensive practitioner- and group support. Thus, the eHealth law of attrition

(Eysenbach 2005) was bypassed, partly thanks to (social) benefits in the context of the ICT. Plus, some cognitive dissonance may have worked to our advantage: if something is a challenge, then people may appreciate their own achievements and results more. This appears to have helped increase motivation for ICT-adoption as well as the extensive lifestyle improvements. Especially in the longer run, their increased self-appreciation and self-efficacy appears to have helped.

7 Conclusion

Summarizing from this study, we can conclude a few key points. First, the 12 weeks of intensive training and coaching sustainably (for 50 weeks at least) improved patients' health awareness, health behaviours, health outcomes and quality of life. Second, a virtuous cycle was started (as noted earlier in other lifestyle eHealth settings, see Simons 2014): better health literacy & behaviours -> better results -> better health literacy & behaviours. This helped patients reverse type 2 diabetes (DM2) progression, lowering all from a very high level of insulin therapy to on average 65% lower levels 50 weeks later, with two patients able to stop insulin therapy. Third, this is a challenging patient group with some being relatively low in health- and ICT literacy. Following the design analysis, the highly simplified solution we created for secure, daily eLogging for sugar/insulin for this group was relatively useful. All patients used it well and it enabled everybody involved to closely monitor progression. Regarding other eTools, appreciation and use varied, and future work is needed to increase long term effectiveness and e-relationship building.

This preliminary analysis has several limitations. First, this is only a pilot study with 11 participants. Second, the 50-week data analyses are not complete yet; more biometric and behaviour data analyses still need to be done. Third, regarding external validity, these study results may only apply to motivated individuals, who volunteer for lifestyle training. Fourth, it can be argued that TAM is not the only suitable instrument for evaluating technology adoption. For example, UTAUT (Venkatesh 2003) is also viable. However, UTAUT was developed and validated in organisation contexts, where functional aspects of information systems adoption (like performance and effort expectations) are relatively important. In consumer contexts, items regarding 'Attitude towards Use' are relevant as well (Carlsson 2006), and those are part of TAM.

Still, on the positive side our results (biological, behavioural, TAM) prove relatively robust across the 11 participants, even though they are diverse in background (education, gender, age, insulin medication levels and co-morbidity, health literacy, coping and learning styles). And this pilot provided an opportunity for design analysis regarding the hybrid service mix deployed and opportunities for long term e-relationship building.

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Developing a Mobile Application for Managing Anaphylaxis: Discovering Critical Success Factors

KOEN SMIT, JORIS MENS & MATTHIJS BERKHOUT

Abstract Anaphylaxis is a severe and potentially life-threatening allergic reaction that requires immediate treatment. A proposal for the development of a mobile application for supporting anaphylaxis patients was written by a team of allergists, after which this study was performed in order to identify critical success factors for the adoption of such an app. A mixed-method approach is used in order to gather data from a variety of sources, comprising a literature review, a domain expert interview, and a patient survey. One of the most valuable factors proved to be the validation of the medical information provided in the app. Besides this, patients are mostly concerned with the clarity of the presented information. While the proposed app does not fulfill all the identified factors, its development is overseen by medical professionals and endorsed by patient organizations. With a lack of such apps in the Dutch market and the demand indicated by survey respondents, this app has the potential to fill a gap in the support of anaphylaxis patients.

Keywords: • Allergens • Anaphylaxis • Apps • Healthcare • Mobile •

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1 Introduction

In this paper, we study a mobile application (app) for supporting anaphylaxis patients. The app was proposed by a team from the department for allergology at the University Medical Center Utrecht (UMCU), a large academic teaching hospital in the Netherlands. The app will be developed in collaboration with physicians and patient groups supporting anaphylaxis patients. Anaphylaxis is a type of immediate allergic reaction categorized as type 1 hypersensitivity (Gell & Coombs, 1963), further defined as "... an acute, systemic reaction caused by mast cell–mediator release [which is] potentially life threatening" (Yocum et al., 1999). Anaphylaxis may be caused by a number of triggers, also called anaphylaxis agents, such as foods, medication, insect bites or contact with latex (Kemp & Lockey, 2002). Anaphylactic reactions cause symptoms which may be life-threatening and require an emergency response (Schwartz, 1994). The proposed app is intended to support anaphylaxis patients and their caregivers by providing step-by-step assistance in the case of an anaphylactic reaction.

Exposure to allergens that cause anaphylactic reactions may occur via ingestion, inhalation, injection or direct contact (WAO, 2012). Anaphylaxis manifests itself through symptoms such as flushing and itchiness of the skin, difficulty breathing, swelling of the mouth or eyes or an abnormal heart rate (Sampson et al., 2006). An anaphylactic reaction is usually treated by administering a dose of epinephrine (adrenaline) intramuscularly into the thigh using an auto-injector, after which the patient should be admitted to a hospital for further treatment and observation (Sampson, 2003).

The exact prevalence of anaphylaxis is difficult to establish, as people may develop sensitivities to allergens at different points in life, or may be unaware of sensitivities to allergens they have not yet been exposed to. Different studies indicate a 0.5% to 2% prevalence in the world's population (Simons, 2010), a 1.21% to 15.04% prevalence (Neugut, Ghatak, & Miller, 2001) and a 1.6% to 7.7% prevalence in the US population (Wood et al., 2014). Data provided in the app's proposal indicates the prevalence of diagnosed food allergy in The Netherlands at 1-2% in adults and 1-3% in children, with 90% carrying emergency medication. For insect bites, the prevalence is 1-3% among the Dutch population. The morbidity and mortality of anaphylaxis are believed to be underestimated due to limited data on its incidence (Brown, McKinnon, & Chu, 2001; Neugut et al., 2001). Evidence points towards an increase in anaphylaxis prevalence (Liew, Williamson, & Tang, 2009), which may be attributed to changes in diet and medicine use (Sheikh & Alves, 2000).

Besides the physical symptoms, anaphylaxis is shown to have a societal impact by leading to a decreased quality of life and limiting of social activities for children (Sicherer, Noone, & Munoz-Furlong, 2001), as well as proneness to school absence and decreased participation in the labour market for adolescents (Marklund, Ahlstedt, & Nordström, 2007). Several patient groups aim to support anaphylaxis patients by providing information on the internet. Examples are the National Foundation of Food Allergy (in

Dutch: Stichting Voedselallergie) and the Dutch Anaphylaxis Network (in Dutch: Nederlands Anafylaxie netwerk).

This study aims to determine the critical success factors for the adoption of the proposed anaphylaxis app. To achieve this, we conducted a mixed method approach, containing a literature review, a domain expert interview, and a patient survey. The research question addressed in this paper is defined as follows:

RQ: “What are critical success factors for user acceptance of an app to support patients suffering from severe allergic reactions?”

The remainder of this paper is organized as follows. First, we provide information with regards to the anaphylaxis app that will be developed by UMCU, analyze similar apps and identify (critical) success factors for the adoption of such apps in literature in the background and related work section. This is followed by the research method in section three. In section four, the results of the mixed method approach are presented. Lastly, in section five, we reflect on the results and applied research methods in the discussion, conclude upon our study, and propose possible directions for future research.

2 Background and related work

In this section, the anaphylaxis app will be presented and compared to existing applications. Additionally, the literature with regards to Critical Success Factors (CSFs) is explored and discussed upon.

2.1 The anaphylaxis app

The anaphylaxis app studied in this paper was proposed by a team at the department of allergy at the UMCU. The proposal entails a request for funding, which will be needed to start the development of the app for Android and iOS. Currently, no actual app or prototype exists. Development of the app will be performed by the Medical Apps Co-creation Center, also known as MAC³. MAC³ provides centralized services for the development, testing, and research of medical apps. The author of the proposal was interviewed in order to gather background information on the app.

The team at UMCU collaborates with the National Foundation for Food Allergy, the Dutch Anaphylaxis Network and the domain group for eczema, which is a part of the Dutch Society of Dermatology and Venereology. These contacts are used to establish requirements for the app and to foster its acceptance in the medical community.

The purpose of the app is to provide a better alternative compared to the leaflets that are usually given to patients by physicians, alongside anaphylaxis medication. Such leaflets provide information on emergency procedures but are not always carried by the patient. The app should improve the availability of this information by residing on the

smartphones of patients or caregivers. The information provided will be personalized depending on the type of reaction (caused by food or insect bites), the severity of the reaction and the medication the patient uses. Information on reactions caused by other, less common triggers is not explicitly included, but may be covered by the available information on treating reactions caused by food or insect bites.

Besides providing assistance in the case of an allergic reaction, the app will provide background information on allergic reactions to be consulted at any time. While similar apps already exist in countries such as the UK and Australia, an app geared towards the Dutch market that is endorsed by patient organizations and contains validated medical information and instructions is not yet available. Country-specific apps are also needed because of differences in medications available per country.

2.2 Related apps/games

The current offering of anaphylaxis-related apps was studied in order to explore similarities and differences compared to the proposed app. Apps were collected by performing the search query: ‘Anaphylaxis’ and ‘Allergy’ on the Google Play Store and the Apple App Store, including related apps for any identified app that resulted from our search. The apps and their characteristics, features, and ratings are compared in Table 1.

Table 1: Related app comparison

Name	Anaphylaxis	Jext	Anaphylactic Shock	Anaphylaxis101	Anaphylaxis Allergy
Developer	Coventry Univ.	ALK-Abelló	Small cog	Mylan	Phacia Inc.
Platform	iOS	iOS, Android	Android	iOS, Android	iOS
Price	Free	Free	€ 1.16	Free	\$ 0.99
Install base	Unknown	100-500	10-50	100-500	Unknown
Target market	UK	UK	General	US	US
Vendor-specific	No	Yes	No	No	No
General information	Yes	Yes	Yes	Yes	Yes
Personalized advice	Yes	Yes	No	No	No
Emergency contacts	Yes	Yes	No	No	Yes
Expiry reminders	Yes	Yes	No	No	No
Facility Locator	Yes	No	No	No	Yes

Most apps provide similar functionalities, some being more extensive than others. Such functionalities may include general information about anaphylaxis and allergies, instructions for emergency procedures and the use of auto-injectors, medication expiration reminders and interactive maps for finding nearby medical facilities. All apps found are aimed at anaphylaxis patients or caregivers. As evidenced by the available data on the number of installations, there does not appear to be one particularly popular anaphylaxis app. Install base data is only available on the Google Play Store and not on the Apple App Store. In terms of ratings and evaluations of the app, no information was found originating from independent sources.

Some of the compared apps are free to use, while others require a small fee. Apps such as the one made by Coventry University are intended for a more general audience of anaphylaxis patients, while the Jext app developed by ALK-Abelló is to be used specifically by patients using Jext-branded auto-injectors. The former app is also the only app found that is endorsed by a local patient organization, namely the UK Anaphylaxis Campaign.

2.3 Critical success factors

The current body of knowledge on critical success factors in the context of this study consists of research on both (mobile) allergy management in general and anaphylaxis management. The available literature, which consisted of nine relevant papers, is presented in three main categories; preventative information, providing assistance, and mobile healthcare.

2.3.1 Preventative information

Mobile technology is used in several ways to support patients suffering from allergies or anaphylaxis. One of these ways is providing preventative information by enabling patients to scan food items or medications through the use of barcode or NFC technology. A general study into smartphones and barcode scanning by Eichler & Luke (2009) describes a prototype developed by Deutsche Telekom Laboratories called 'Allergy Warner', which provides an alert message when scanning barcodes of food products in the supermarket. The app will contain a personalized allergy profile which looks for matching ingredients in the scanned products. Eicher & Luke argue that modern smartphones can quickly and easily scan and recognize multiple types of barcodes, making them suitable for this purpose.

A similar study by Gassner, Vollmer, Prehn, Fiedler, & Ssmoller (2005) concludes that reliable information about food products is difficult to obtain because of different interests of stakeholders in the food value chain. A mobile app that provides such information would fill a gap in the market. Ottenhof (2010) provides a proof of concept for a device-based solution (DBS) that allows customers in supermarkets to scan product packages for allergy information. However, Ottenhof concludes that a lack of information provided by manufacturers proves to be an obstacle. Stierman (2009) found that scanning product packages make it easier for patients to retrieve allergen information. Patients were more likely to buy products they were unfamiliar with thanks to a scanning solution.

A study by Möller, Diewald, Roalter, & Kranz (2012) evaluated an application called MobiMed, which allows users to scan medicines in different ways, either through text search, barcode scanning, visual search or Near Field Communication (NFC). This app could then be used to warn patients for medicines that would put them at risk of allergic reactions. Extracting information through NFC was found to be the fastest and most preferable method because the user does not need to search for and scan a barcode. However, the integration of NFC technology in smartphones and packaging is not yet widespread.

Ottenhof (2010) found that NFC (or similarly, RFID) technology provides the best matching capabilities because of its high storage capacity and the possibility to tag products on an item level rather than by product type. While this information is easily extracted by modern smartphones, the implementation of RFID/NFC on packaging is

relatively expensive. Scanning of standard EAN-13 barcodes is the cheapest in terms of implementation since products are already equipped with these barcodes. However, EAN-13 has a low storage capacity and can only identify products on a product level. A backend that provides additional information would be needed. Problems could occur when the composition of one type of product with the same barcode changes over time.

When looking at the current literature on providing preventative allergy information to patients, we can conclude that there are still some improvements that can be made to cater to patients. In terms of retrieving the information, a universal, fast and cost-effective method needs to be found to provide contextual information about physical products on a smartphone. Additionally, manufacturers of medicines and food products need to provide allergen information that is easily accessible for consumers.

2.3.2 Providing assistance

A series of works by Hernandez et al. describes a personal mobile health device and the associated app used to alert emergency services automatically when an auto-injector is administered to a patient (Hernandez Munoz & Woolley, 2009, 2010; Hernandez Munoz, Woolley, & Baber, 2008). The solution, called PervaLaxis, uses an accelerometer connected to an auto-injector to detect its usage, which is signaled wirelessly to a smartphone using Bluetooth. Emergency services can be contacted automatically through the phone.

In a later study, PervaLaxis was further validated by involving patients (Hernandez Munoz & Woolley, 2010). A pilot study was performed, after which the patient sample was increased over time. Use case diagrams were used to test usability and determine important success factors for the solution. These success factors are reported to be: adrenaline injectors expiry alerts, an emergency support button, and adrenaline injection sensing. Limitations identified for this solution were the reliability of the mobile phone transmission and the accuracy of the injection sensor.

Other works suggest that instructions for providing assistance to patients should be segmented towards different user groups. This may be done based on the age of the patient and the number of years of experience they have with their illness. Further personalization of the app could be of use here (Miles, Valovirta, & Frewer, 2006; Yu & Ramani, 2006).

2.3.3 Mobile healthcare

Obiodu (2012) studied the top 500 medical apps in the Android market and concluded that the majority of apps are designed for healthcare professionals, while it is plausible that most end-users are patients rather than healthcare professionals. One significant problem is that it is often unknown whether medical apps intended for patients provide information that is validated by medical professionals (Haffey, Brady, & Maxwell, 2013).

In practice, it is found that medical professionals are often not involved in the development process of medical apps, or that there is a lack of validated sources available in the app (Buijink, Visser, & Marshall, 2013; Rosser & Eccleston, 2011). Beyond this, there are no obvious signs to distinguish medically validated apps from apps that have not been validated, such as an international mark of quality. When an app does not offer a diagnosis, treatment or cure, it cannot be classed as a medical device and will not be subject to the thorough scrutiny of such medical devices. (McCartney, 2013) However, the general information or advice provided by such a medical app may still cause harm to the patient. An increasing number of apps published and the lack of an international safeguard for monitoring medical apps undermines patient safety (Cook & Nolan, 2011; McCartney, 2013; Visvanathan, Hamilton, & Brady, 2012).

2.3.4 Critical Success Factors

The literature contains 9 relevant contributions with regards to CSFs applicable in our study. The CSFs of the app can be defined as follows:

1. The information is context-aware through scanning of physical objects;
2. The information is easy to retrieve;
3. The information improves the user's understanding of the subject.

When looking at the ability of the app to provide assistance in the event of an allergic reaction and general characteristics of mobile healthcare, the following success factors were identified:

4. The app should provide advice that is validated by medical professionals;
5. The app should provide advice that is tailored to the user's medicines;
6. The app should provide advice that is tailored to the characteristics of the user, such as age or level of experience.

In Table 2, the critical success factors are linked to the papers from the literature review. In the header row, the six CSFs identified earlier are transformed into keywords.

Table 2: Meta-analysis regarding CFSs in the current body of knowledge

	1. Context	2. Ease	3. Understanding	4. Validity	5. Tailored	6. User-sensitive
(Eichler & Lüke, 2009)	✓				✓	
(Gassner et al., 2005)	✓	✓				
(Ottenhof, 2010)	✓	✓				✓
(Stierman, 2009)		✓				
(Möller et al., 2012)					✓	
(Hernandez Munoz et al., 2008)			✓	✓	✓	
(Hernandez Munoz & Woolley, 2010)			✓	✓	✓	
(Hernandez-Munoz & Woolley, 2013)			✓	✓	✓	✓
(Miles et al., 2006)			✓			✓
(Yu & Ramani, 2006)			✓			✓

3 Research method

3.1 Interview

In this section, we describe the setup, deployment and the evaluation of the interview with a domain expert who is a representative and the founder of the Dutch Anaphylaxis Network, known as NAN in Dutch. The NAN informs and provides support to patients while also keeping in touch with stakeholders, such as food producers, on current issues surrounding allergies.

As the interview is semi-structured of nature, the following topics are discussed:

1. The current necessity of an app;
2. Existing knowledge on mobile applications concerning allergy or anaphylactic patients;
3. Critical success factors concerning user acceptance of an app;
4. Additional comments or advice.

With regards to CSFs, the domain expert was first invited to provide his own insight into possible CSFs and then asked to evaluate the CSFs identified during the literature review. This was done in order not to create a possible bias by first presenting our findings derived from literature.

3.2 Survey

Following the literature review and domain expert interview, a survey was conducted among a sample of patients in order to gather further data on CSFs. As described in section one, the proposed app is aimed at the Dutch market, with a prevalence of diagnosed food allergy at 1-2% in adults and 1-3% in children, with 90% carrying emergency medication. For insect bites, the prevalence is 1-3% among the Dutch population, as indicated by the proposal of the app. All patients in The Netherlands who may be at risk for anaphylactic shock are included in the scope of the survey.

The survey was designed to first establish basic information about the patient, such as their age and the number of years of experience they have with anaphylaxis. The patient was also asked if they are familiar with smartphones, including the total years of use and a self-assessed competency rating. A number of possible functionalities for the app were presented to the participants, for which they could indicate their desire for such a functionality in an anaphylaxis app on a Likert scale. These functionalities were adopted and where needed adapted from results of the literature review and domain expert interview. An open-ended question provided respondents the possibility to provide additional functionalities. The ratings given for the functionalities were then used to determine the most valuable functionalities and therefore CSFs for the adoption of the app. Another set of questions adopted from the System Usability Scale (SUS) and Technology Acceptance Model (TAM) determined which usability factors were deemed most important by patients, such as the clarity of the presented information and the interactivity of the app. Finally, the respondents were asked to rate the likeliness of using an anaphylaxis app on a scale of 1 to 10.

4 Results

In this section, the results of the interview and the patient survey are presented.

4.1 Domain expert interview

The domain expert was positive about the concept of an anaphylaxis app. There is a necessity for such a solution in the domain. With regard to replacing paper leaflets, an app may be useful, but only until the patient has familiarized himself with the information. After this, the app will need additional functionalities to engage and support the patient, such as training users to identify and avoid possible anaphylactic triggers.

The domain expert identified the following CSFs for the adoption of an anaphylaxis app:

1. The app should focus on including avoidance strategies for potential anaphylactic triggers.
2. The app should include gamification, such as a quiz used to test knowledge on allergens and emergency procedures, both for the patient, caregivers as well as friends or family.
3. The app should focus on different user groups since the information needs of each group can differ. Adolescents may more easily ignore food warnings, for example, making it necessary to address them in a different way.
4. The app should be interactive, rather than just providing static content.
5. The app should be free. Earlier research by the domain expert concluded that paid-for apps lead to low adoption rates among patients.

4.2 Patient Survey

Contacting patients directly through UMCU proved to be difficult and time-consuming due to the clearance procedures involved. The decision was therefore made to deploy the survey on the website of the NAN, with help of the domain expert interviewed earlier. The NAN receives about 500 unique visitors per day on their website. The survey was featured on the front page for a period of 6 days between from the 21st up until the 26th of June 2014. Patients could voluntarily and anonymously fill out the survey on the website.

276 respondents filled out the survey. The sample consists out of 16.7% male and 79.7% female respondents (3.6% unknown), with an average age of 40.96 years ($s = 11.17$). Our respondents have an average of 9.81 years of experience with anaphylaxis ($s = 7.514$). 93.1% of respondents indicate owning a smartphone. With a 46% percent share, Android is the most used mobile operating system, closely followed by iOS at 39.1%. The remaining share goes to other or unknown operating systems (13.8%) and Blackberry (1.1%). The average number of years respondents have been using a smartphone is 3.95 years ($s = 2.511$). They rate their own competency in the use of mobile phones with a 7.75 ($s = 1.797$) on a scale of 1 to 10.

The desirability of an app to support anaphylaxis patients is rated with an average of 8.34 on a scale of 1 to 10 ($s = 1.787$), while the probability of the respondents using such an app is rated with an 8.75 ($s = 1.903$). The three most compelling app features indicated by respondents are the clarity of the information, the medical validation of the information, and the availability of information regarding emergency procedures, with average scores of 6.68, 6.62 and 6.48 on a scale of 1 to 7, respectively. The aspect rated as least important are the presence of an element of play (gamification), a quiz to test allergy knowledge and interactivity of the app, with average scores of 2.66, 3.33 and 4.50, respectively. All CSFs are shown in table 3.

Table 3: Survey results

	N	Mis sing	Me an	Std. Deviation
The app must present the information in an organized manner	274	2	6.68	0.651
The app must have a medical validation of the provided information	275	1	6.62	0.799
The app must scan product barcodes for information	273	3	6.48	0.944
The app must give information about emergency procedures	274	2	6.48	0.999
The app must have a list of predefined emergency contacts	275	1	6.43	1.038
The app must give advice about allergy triggers	276	0	6.31	1.328
The app must give advice about the expiration date of the medicine	274	2	6.18	1.23
The app must give guidance for recognizing products with specific ingredients	275	1	6.11	1.35
The app must have guidance for recognizing specific ingredients	276	0	6.03	1.366
The app must give advice about the used medicine	276	0	6.03	1.373
The app must be free of charge	274	2	5.48	1.781
The app must be able to share my allergy information with my surroundings	276	0	5.34	1.799
The app must look attractive	276	0	5.03	1.523
The app must show basic information about allergies	273	3	4.73	1.953
The app must be interactive	274	2	4.5	1.895
A quiz to test the knowledge about allergies	273	3	3.33	1.827
The app needs a challenging game element (gamification)	274	2	2.66	1.694

The open-ended question in the survey asking patients for other desirable functionalities yielded many results. The functionalities provided were categorized by similarity. 22 respondents indicated the desire for a functionality that helps to translate allergens and emergency instructions into another language for when the patient is traveling. 12 respondents wish for an alarm button that can quickly contact emergency services and other predefined contacts, and another 12 respondents wish for a newsfeed containing updates on medication or treatments.

5 Conclusion & Discussion

The research questions addressed in this paper was defined as follows: What are the critical success factors for user acceptance of an app to support patients suffering from allergies? To answer this research question, we looked at the results of the analysis of the

current body of knowledge, the domain expert interview and the patient survey that were performed during this study. The various factors gathered from different sources indicate that a broad range of features is possible in an app that supports anaphylaxis patients. However, different features may appeal to different subgroups of patients depending on the severity of their symptoms, their age, and experience with their illness, among other factors.

In literature, a number of studies were found concerning food allergies in general and specific measures for anaphylaxis. The studies on food allergies noted the possibility to scan food packaging as a critical success factor for user adoption in their specific context. The studies related specifically to anaphylaxis, such as the study concerned with automatically detecting the activation of an adrenaline injector through a Bluetooth accelerometer, were more concerned with the validity of the information provided by the accompanying app. However, the UMCU has already indicated that such features will not be included in the app at this time. The factors that remain, based on literature, are that the app should contain medically validated information, be easy to use and improve the user's understanding of the subject, and be sensitive to different user groups. The proposed app will adhere to these factors.

The domain expert indicated a number of new factors mainly relating to the interactivity of the app and having certain quiz or gamification elements that test the knowledge and train them to avoid allergens. Another factor mentioned was that the app should be free in order to boost user adoption. Patients surveyed agreed with this, although they did not appear to be very enthusiastic about gamification or quizzes. Once more, new factors were introduced after the patient survey such as the ability to translate allergens and procedure information, providing a newsfeed and a list of predefined emergency contacts. The factors for the medical validation of the information and the availability of clear emergency procedures were also rated highly by patients. Another interesting factor is that patients indicated they would overall be very likely to use such an app.

In relation to all of the features that were established in this study, the proposed anaphylaxis app appears to be relatively limited in features. However, the team at UMCU has indicated that the proposed app should be simple and straightforward to use. The decision was made not to include features such as scanning of objects or giving extensive information on types of food that contain allergens. Even though the app does not contain all functionalities that may be seen as critical success factors, the app may still prove to be of added value for patients when its functionalities are fit for purpose. The simplicity of the app will also contribute to the clarity of the information, which was another success factor.

An effectiveness study will have to reveal the actual usefulness of the app for patients. The current body of knowledge related specifically to anaphylaxis apps is rather small and anaphylaxis apps are a relative niche market within the medical app landscape, making it difficult to predict the effects the CSFs will have on actual user adoption.

Beyond this, we recommend the team at UMCU looks into the possible expansion of the app in the future, in order to include some of the features that were indicated as being desirable for patients. Moreover, our results also indicate a selection of lower rated functionalities for the app. For example, the functionality that was rated lowest in our results was the functionality regarding the addition of a challenging game element (gamification). While we believe that our survey was conducted with the aim to gather data from the appropriate user groups, some of the respondents indicated to be a parent or caregiver. This is usually the case with younger children. There could be a difference between how a sample drawn solely from patient groups versus our sample rate the functionalities presented in a survey. Currently, our results are difficult to link with the existing body of knowledge as no uniform opinion exists on the importance of CSFs and related functionalities.

Besides the methods used in this study, further validation should be performed using other patient organizations, medical professionals, domain experts, and patients. In this study, we were only able to contact one medical professional (the author of the proposal for the development of the app) and one representative of a patient organization (the domain expert). Therefore, the results of the survey could be affected by the input from the results of the interview, which were derived from one subject-matter expert. The generalizability of our results could be improved by involving more subject-matter experts from different perspectives (i.e. medical specialties, medical informatics, and academics). In addition to the Dutch market, the development team could also get into contact with other international organizations who have previously developed similar apps in order to find out more about their lessons learned.

All in all, we believe that the current potential success of the app lies in the fact that it is being developed by medical professionals in collaboration with patient organizations, which is a highly regarded success factor. In addition, the app will be available for free and is targeted towards the Dutch market, where no such app currently exists. The information given about emergency procedures may indeed prove to be a useful replacement to paper leaflets, once doctors start prescribing the app alongside anaphylaxis medications. From a theoretical perspective, our study provides an overview of CSFs and the importance of those CSFs in the context of a substantial Dutch sample geared towards the development of an app to manage anaphylaxis. From a practical perspective, our results provide direct evidence and directions for development and help in the prioritization of the development of functionalities in similar apps.

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Transforming Clinical Practice Guideline Usage Through the Use of a Clinical Decision Support System: An Explorative Study at the University Medical Centre Utrecht

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Abstract Medical treatments require a lot of knowledge and skills. To safeguard the quality of healthcare in general, Clinical Practice Guidelines (CPG) are written. Different studies show that the quality of healthcare improves by using CPGs. Based on the advancements in IT, a CPG could best be supported through the use of a Clinical Decision Support System (CDSS). In this paper, we seek to transform the use of several CPGs with regards to anti-clotting medicine and treatments through the utilization of a CDSS at the University Medical Centre Utrecht (UMCU) in the Netherlands. Data analysis shows that many of the included CPGs overlap and that the utilization of a CDSS for the determination of anti-clotting medicine and treatments could result in more effective and efficient decision making. Additionally, during the validation of the CDSS, we derived the attitude of the stakeholders towards the use of a CPG in a pilot study comprising a CDSS and identified several success factors that should be taken into account when designing, validating, and implementing CPGs into CDSS.

Keywords: • Clinical Practice Guideline • Clinical Decision Support System • Medical Treatment • Healthcare •

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1 Introduction

Medical protocols are used by physicians as guidelines to perform a diagnosis and subsequently a treatment that fits that diagnosis. These protocols, also referred to as Clinical Practice Guidelines (CPGs), are defined and maintained by medical organizations such as hospitals, but also by national or international governing medical institutions. A CPG may offer specific instructions on which diagnostic or screening tests to use, how to provide medical or surgical services, the duration that patients should stay in a hospital, or regarding other details of clinical practice. These CPGs may contain overlapping content between different medical specialties. To help to determine the right decision for an accurate diagnosis, despite the redundancy (Alonso-Coello et al., 2010), it is possible to implement the different protocols into one Clinical Decision Support System (CDSS).

A CDSS can be described as the provision of the knowledge of clinical experts in combination with patient-related information in an information system (Chang et al., 2011). Medical knowledge and patient-related information combined are filtered and presented at the times necessary. These actions are performed to improve patient care by providing an accurate decision on what medicine and corresponding treatment to adhere to (Chang et al., 2011; Minutolo, Esposito, & De Pietro, 2012). Essentially, CPGs are an accumulation of rules with regards to diagnostics, medication and treatments, thus these rules can be programmed in a CDSS. This research paper will explore how the existing anti-clotting CPGs at the University Medical Centre Utrecht (UMCU) can be embedded into a knowledge model to be implemented in a CDSS to support decision making.

A similar study by Ozel, Bilge, Zayim, & Cengiz (2013) focused on the development and evaluation of a web-based CDSS that supports Intensive Care Unit providers in making decisions more efficient and effective. This particular study states that “The aim of the study was to develop a supportive web-based system which was constructed in line with the needs and preferences of intensive care physicians and evaluate its efficiency, effectiveness and usability” (Ozel, Bilge, Zayim, & Cengiz, 2013). In contrast to this study, the challenge addressed in this paper is the development of a CDSS containing eight CPGs, each from different specialties at the UMCU. Currently, when the diagnostic, medicine and treatment variables have to be determined for a patient, all involved specialties have to discuss the best course of action, based on their specific CPG.

To ensure that medical professionals with different specialties and backgrounds follow decision-making processes in a consistent manner, it is important that the different CPGs are combined (Alonso-Coello et al., 2010). A successful implementation of CPGs into a CDSS will provide stakeholders in medical processes with the ability to systematically make decisions in an effective manner, without the need to discuss medicine and treatment variables with each specialism. Furthermore, the utilization of a CDSS for decision making could result in a reduced error margin as the decisions supported can be

evaluated appropriately (Ozel et al., 2013). The evaluation of the output is important as it enables the CDSS to ‘learn’ to provide more accurate decision-support (Jiménez-Serrano, Tortajada, & García-Gómez, 2015). To ground our goal to develop a CDSS for the determination of anti-clotting medicine and treatment, the following research question is formulated;

RQ: “How can the available anti-clotting CPGs of the UMCU be combined into a CDSS with the aim to support decision making and increase adoption of the CDSS?”

The remainder of this paper is organized as follows: in section two the background and related work with regards to CPGs and CDSSs will be explored. Next, the research method is presented in section three. This is followed by section four in which the data collection and analysis are described. Finally, in section five the results of our study are presented and in section six we draw conclusions from our results followed by a discussion with regards to the research study conducted, after which we provide directions for future research.

2 Background and Related Work

In literature, several definitions for a CPG exist. In our study, the following extensively cited definition from Field & Lohr (1990) will be used: “systematically developed statements to assist practitioner decisions about appropriate healthcare for specific clinical circumstances.” Since CPGs are developed and implemented in the clinical practice, it has shown a lot of potential for the improvement of the quality of the healthcare (Grol, 2001; Lugtenberg, Burgers, & Westert, 2009). The combination of scientific literature and evidence with insights from clinical experts form the basis for a CPG, usually published by national medical governing bodies, for example, the Dutch College of General Practitioners (NHG) or the American Institute of Medicine and are further specialized and instantiated per hospital. Based on this, recommendations are developed on specific clinical subjects. For example, a clinical subject (i.e. coronary heart disease) is given a score based on the insights from the clinical experts, the height of the total score determines what treatment is supposed to be given. The recommendation according to the score is always backed by scientific literature. These recommendations provide professionals working in healthcare guidance, whom in some cases don’t have the expertise required to effectively and/or efficiently determine medicine and treatment for a patient (Davis & Taylor-Vaisey, 1997). A couple of proven benefits that CPGs realize in the clinical domain are: 1) decision making on appropriate care for patients, 2) promote education and improvement of care processes, 3) reduce unwanted variation in the delivery of health care, and 4) help contain costs. Most of these positive attributes are similar with the benefits from CDSSs (Grol, 2001; Lugtenberg et al., 2009; Woolf, Grol, Hutchinson, Eccles, 1999). However, the utilization of CPGs also poses stakeholders with challenges like how to maintain CPGs so that state-of-the-art knowledge is guaranteed (Shekelle et al., 2001) and how to ensure the validity of its contents (Browman, 2000).

2.1 Implementation of CPGs

For a CPG to be effectively utilized, it needs a successful implementation. Multiple studies show that in some cases, after the dissemination of the CPGs, there is a lack of usage in the clinical practice (Cabana et al., 1999; Grol, 2001). A part of the problem is the lack of behavior change by the physicians, this is mostly caused by a lack of agreement with CPGs itself (Gravel, Légaré, & Graham, 2006; Members et al., 2017). The lack of agreement can be based on specific factors, for example, a lack of confidence in the author, or it can be based on the lack of agreement in general (Cabana et al., 1999). Other identified reasons for a failing implementation of CPGs can be the wrong distribution of the CPGs (Grol, 2001). Although these are serious concerns for the adoption and utilization of CPGs, two studies show that, in the Netherlands, a high acceptance and feasibility level is achieved for the development and implementation of CPGs (Grol, 2001; Lugtenberg et al., 2009).

Although CPGs help stakeholders in the diagnosis and treatment of diseases, another challenge exists. Most CPGs are printed on paper, which limits practical clinical use (Davis & Taylor-Vaisey, 1997). This is one of the reasons that Clinical Decision Support Systems (CDSSs) are developed (Lamy et al., 2010). The combination of the knowledge of clinical experts with patient-related information is filtered and presented by a CDSS when it is required. There are different sorts of CDSS archetypes. According to Power (2008) those are 1) Model-driven, 2) Data-driven, 3) Communication-driven, 4) Document-driven and 5) Knowledge-based CDSSs.

2.2 Clinical Decision Support Systems

Knowledge-based systems are used most and proved most efficient in the CDSSs setting (Sanchez et al., 2013). Knowledge-based systems hold knowledge about a (clinical) domain. In the (clinical) domain, this knowledge is the understanding of the problems and skills for solving these problems (Kalogeropoulos, Carson, & Collinson, 2003; Sanchez et al., 2013). Knowledge-based systems mostly use ontologies for structuring the knowledge. In this paper, we use ontologies that refer to an engineering artifact, as formulated by the popular work of (Guarino, 1998): “These are constituted by a specific vocabulary used to describe a certain reality, plus a set of explicit assumptions regarding the intended meaning of the vocabulary words. This set of assumptions has usually the form of a first-order logical theory, where vocabulary words appear as unary or binary predicate names, respectively called concepts and relations.”

Some of the benefits that CDSSs provide are: 1) Providing knowledge to medical professionals at appropriate time and manner, 2) Facilitating an efficient and effective decision making, 3) Reducing preventable medical errors, 4) Improving the overall quality of healthcare for patients and 5) Serving as a didactic tool for critical learning for medical students (Chang et al., 2011; Sanchez et al., 2013). Several studies have proven

that CDSSs improve the clinical practice and practitioner performance by respectively 64% and 68% (Garg et al., 2005; Kawamoto, Houlihan, Balas, & Lobach, 2005). A recent implementation of a web-based CDSS in an intensive care unit in Turkey shows that the CDSS significantly (positively) contributed in the accuracy of the decision-making by the physicians (Ozel et al., 2013). Although the time for making decisions wasn't reduced, this study did show that user satisfaction and usability were high. In two test scenarios, 150 questions were posed. In the first scenario, the participants needed to answer these questions without the support of a CDSS, in the second scenario, the CDSS supported the decision-making by the participants. Without the support of a CDSS, 24% of the answers were correct, with the support of a CDSS the number of correct answers increased significantly to 83.2%. Finally, the study states that there is a great need for research and development of CDSSs, especially in the Intensive Care Unit (ICU), since the ICU produces large volumes of data (Ozel et al., 2013).

Since the clinical environment is always developing and changing, the knowledge in CDSSs requires a high level of modifiability and maintainability. However, when changes are made in CPGs, it is hard to implement these in the CDSS. This is because it requires both the expertise of the clinical domain as well as the informatics domain (Lamy et al., 2010; Minutolo et al., 2012; Ozel et al., 2013). A possible solution for the problem is simplifying the manner in which knowledge can be modified within CDSSs. This particular functionality is referred to as knowledge editing. If this functionality is simplified in a way that requires less expertise in the informatics domain, adoption of the change process by clinical experts increases as it becomes more easy to modify the CDSS knowledge based on changes in CPGs. For example, this can be achieved with the visualization of the knowledge in schematic plans such as an event-based decision tree (Minutolo et al., 2012).

3 Study Design

To construct a CDSS and assess the value of the knowledge in the CDSS, a three-phase research design has been implemented. The first phase comprised the analysis of eight anti-clotting CPGs, followed by the construction of the actual knowledge in the CDSS. The second phase consisted of the validation of the content of the knowledge in the CDSS by a group of medical stakeholders at the UMCU. The third phase comprised the refinement based on the feedback that was received from the medical stakeholders, which was followed by another round of validation, but in an individual setting with the additional goal to evaluate the utilization of CPGs through a DSS.

An important factor in determining the appropriate research method to validate the CDSS is the maturity of the research field. In literature we identified several developments and trends regarding the use of DSS in a medical context, however, the research field of CPG usage through a DSS in the Dutch context, to the knowledge of the authors, is still nascent. According to Edmondson & Mcmanus (2007), the focus of research in nascent research

fields should be on identifying new constructs and establishing relationships between identified constructs. Therefore the construction of the consolidated anti-clotting CPG will be performed using a round of secondary data collection and analysis, consisting of documents regarding the eight anti-clotting CPGs available at the UMCU.

As our goal is to validate the CDSS and to explore the challenges related to the adoption of a CDSS at the UMCU, a wide range of possible ideas or solutions should be explored from different stakeholders. An adequate research method needs to be used to explore a broad range of possible ideas and/or solutions from a complex issue and combine them into one view when a lack of empirical evidence exists. In this light group-based research techniques are adequate (Delbecq & Van de Ven, 1971; Okoli & Pawlowski, 2004; Ono & Wedemeyer, 1994). Examples of group based techniques are Focus Groups, Delphi Studies, Brainstorming and the Nominal Group Technique. The main characteristic that differentiates these types of group-based research techniques from each other is the use of face-to-face versus non-face-to-face approaches. Both approaches have advantages and disadvantages, for example, in face-to-face meetings, provision of immediate feedback is possible. However, face-to-face meetings have restrictions with regard to the number of participants and the possible existence of group or peer pressure. To ground our research results and to eliminate the disadvantages, we combined the face-to-face and non-face-to-face technique by means of applying a focus group as well as individual semi-structured interviews.

4 Data Collection & Analysis

Data for this study is collected over a period of two months, between November 2016 and December 2016, through 1) secondary data analysis, 2) one round of validation utilizing a focus group session, and 3) one round of validation utilizing individual semi-structured interviews, see also Figure 1. All three methods of data collection and analysis are further discussed in the remainder of this section.

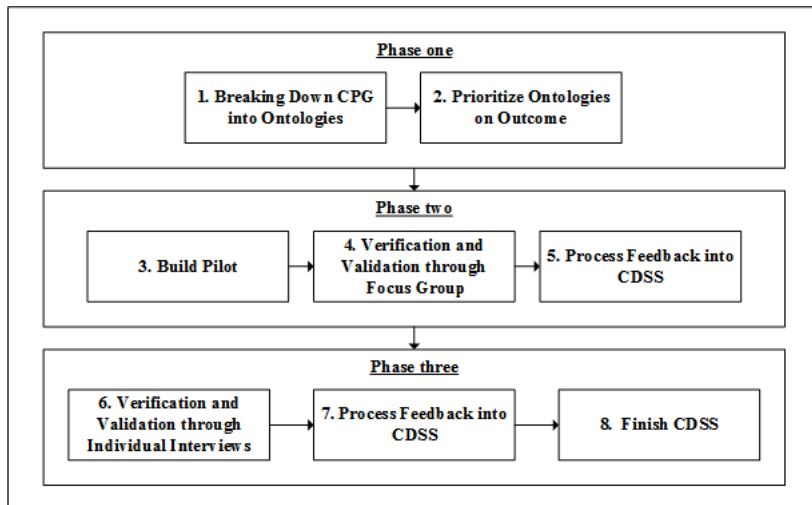


Figure 1: Development process overview

4.1 Modeling of UMCU CPGs

In the first phase, the eight CPGs of UMCU had to be collected and transformed into ontologies to understand the process of a medical examination and to be able to model them in the CDSS pilot at the UMCU. One challenge was that the team of researchers, consisting out of three researchers with experience in knowledge modeling and three researchers with experience in the field of CDSSs, quickly came to the conclusion that the CPGs are predominantly textual documents that rarely visualize the process. The CPGs included in this study were: 1) Bridging Vitamin K Antagonists, 2) Direct Oral Anticoagulants, 3) Heparin-Induced Thrombocytopenia, 4) Unfractionated Herapine Use, 5) start Vitamine K Antagonists, 6) Profylaxe Venous Thromboembolism, 7) Venous Thromboembolism, and 8) Nerve and Neuraxial Blockade with Anticoagulant. The process of transformation of the CPGs into ontologies was conducted as a cyclic approach. First, the researchers with experience in knowledge modeling analyzed the secondary data and modeled the ontologies to be implemented. These ontologies were then submitted for review by the CDSS researchers. This process was repeated five times before the final CDSS pilot for validation in the focus group was established.

In order create the CDSS, eight CPGs were developed into a model. This model links ontologies collected from the CPGs in the pilot of the CDSS. To make sure that the modeling of the CPGs was performed adequately, the researchers started with the analysis and modeling of only one ontology, which was then validated by the CDSS researchers. When the first CPG was modeled and found valid, the knowledge modeling researchers started with the development of all CPGs involved and repeated the internal validation

process with the CDSS researchers. Based on the developed ontologies, the researchers had to analyze which of the ontologies was characterized by the highest uniqueness as the analysis resulted in overlapping rules and content in the included CPGs. Based on the analysis of the created ontologies, the hemorrhage risk ontology was found most unique and therefore the largest contributor to the determination of anti-clotting medicine and treatment. For this reason, we selected the hemorrhage risk ontology to serve as a basis for the creation of the ‘bridging’ ontology, which contained all decision knowledge from all ontologies to determine anti-clotting medicine and treatment at the UMCU. The ontologies were built using the Decision Support System of BeInformed, a supplier of (C)DSS. The output of the modeling phase was used to prepare and structure the validation of the ontology by means of the focus group session.

4.2 Focus Group Validation

Subsequently, to the modeling of the knowledge into the CDSS, the focus group session was prepared and conducted in December 2016; the session had a duration of one and a half hour in total. Before a focus group is conducted, first, a number of key design concepts need to be considered (Morgan, 1996): 1) the goal of the focus group, 2) the selection of participants, 3) the number of participants, 4) the selection of the facilitator, 5) the information recording facilities and 6) the protocol of the focus group.

The goal of the focus group was to validate the anti-clotting CDSS. Based on this, we selected eight participants. The selection was done in collaboration with the UMCU. The selection consisted of five specialized physicians, from which each one was responsible for one or more of the CPGs included. Furthermore, two pharmacists and one laboratory expert were involved. The focus group was chaired by an experienced facilitator, one of the CDSS research team members. Additionally, one knowledge modeling research member was present to take notes. As the contents of the ‘bridging’ ontology are confidential, the focus group meeting could not be captured via audio or video. Lastly, the protocol of the focus group was based on the CPGs modeled, which were presented one-by-one during the focus group session. This protocol provided each participant the opportunity to provide feedback per CPG.

The results from the focus groups were also utilized to get an impression of the attitude of stakeholders and challenges for stakeholders with regards to the use of a CDSS and develop a list of topics to address in the individual interviews. These particular questions were not posed during the focus group as it would allow for peer pressure amongst the participants, thus would be more appropriate during the semi-structured validation interviews.

4.3 Semi-Structured Interview Validation

After the focus group session was finished the researchers continued to refine the CDSS, for example, by changing the sequence of questions posed by the CDSS and the formulation of the questions. After this, the third phase of this study was conducted, comprising the semi-structured interviews with the same five physicians that participated in the focus group session in phase two. The main goal of the interviews was to validate the refined CDSS based on the feedback provided in the focus group validation session. Furthermore, based on the input of the participants in the focus group session, we managed to develop the following set of four topics that were discussed with each interviewee:

- Experiences with regards to the (personal) current use of CPGs
- Improvements with regards to the (personal) current use of CPGs
- Problems that are anticipated with regards to the use of a CDSS
- Significant features that should be included into the CDSS to promote adoption

As stated in subsection 4.2, each of the interviewed physicians was responsible for one or multiple CPGs. Furthermore, none of the participants had knowledge on what their co-workers had answered. The individual interviews were audiotaped and transcribed within 48 hours. The interview data was analyzed by linking and categorizing answers from the physicians. If several responses matched they were labeled by the researcher on perceived advantages and disadvantages with regards to working with a CDSS. This was then cross-checked by other researchers from the research team to ensure coding accuracy. This approach resulted in patterns with regards to the four topics that were addressed in the interviews.

5 Results

In this section, the results of the three phases executed in this study are reported. First, we present the results of the modeling phase, where we collected, analyzed and transformed the CPGs into ontologies to be implemented into the CDSS. This is followed by the results of the validation focus group session in which we validated the first version of the CDSS and used to prepare the semi-structured interviews. Lastly, the results of the interviews are presented that comprise the validation of the refined CDSS as well as an exploration of the experiences, problems, improvements and significant functionalities with regards to CPGs and CDSSs.

5.1 Modeling phase

The first and most complex CPG was transformed in an understandable way to model in the CDSS. The first step was to extract different ontologies from the CPG. Building rules

on top of those ontologies is a proven method to model medical knowledge (Minutolo et al., 2012). The hemorrhage risk showed to be the most important factor in determining which treatment should be started and therefore, the first ontology the research team started with. When the hemorrhage risk is known, a treatment could be prescribed. The ontologies modeled that comprised the vitamin K antagonist bridging CPG were as follows: 1) Specialism type, 2) Treatment type, 3) Action at anti-clotting treatment, 4) Indications, 5) Anti-clotting treatment Periopera, 6) Thromboembolic complication risk factor, 7) Hemorrhage risk and 8) CHA2DS2-VASc risk factor, see for an example Figure 2.

As stated above, the determination is mostly depended on the level of hemorrhage risk, i.e. whenever a type of surgical intervention depicts a certain risk level, which triggers a certain treatment, none of the other questions about other indications are posed.

In the final model, the surgical interventions were categorized in the different kinds of medical specialism. This resulted in a better overview in the first version of the CDSS. First, the medical specialism was posed, before showing the surgical interventions. As soon as the model behind the first version could make a decision based on the different ontologies included, the CDSS would stop posing questions with regards to possible indications and provides a treatment as a suggestion.

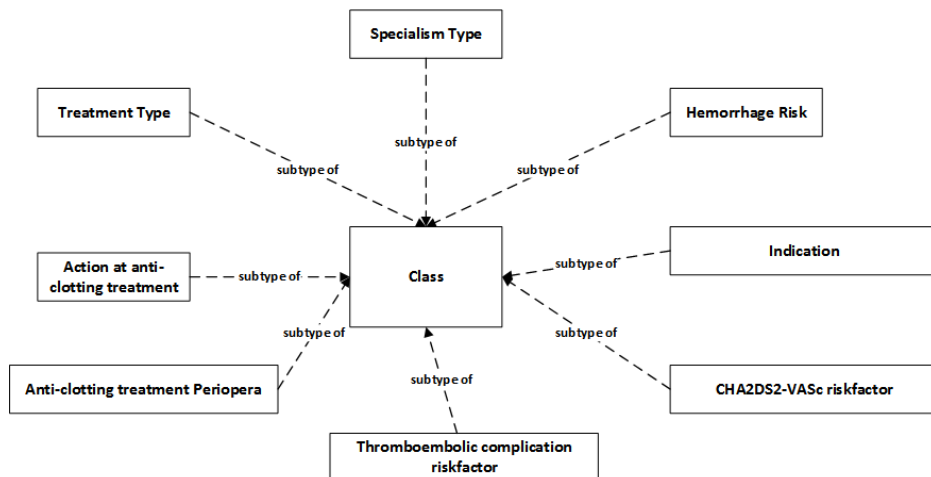


Figure 2: Example high-level excerpt from the vitamin K antagonist bridging CPG

5.2 Focus Group

The first version of the CDSS was presented to the hemorrhage risk commission, consisting of the hemorrhage-related CPG owners, of the UMCU. At this presentation, the bridging CPG was shown in the CDSS. The participants expressed mixed feelings about the first version, although it was predominantly positive feedback. Most of the positive feedback concerned the model-driven method of the CDSS. The participants acknowledged that this was a “powerful” method to overcome the complexity of the CPG. A large amount of feedback with regards to the CDSS was provided by the participants and noted by one of the researchers. This feedback comprised errors in the contents of the model. The feedback was used to refine the CDSS after the focus group session.

Another topic that was addressed during the focus group meeting was the possibility to store decisions made by physicians. It became clear that the focus group saw this as an opportunity to improve the CPGs. Whenever a physician would execute the CDSS and document his or her decision, statistics could provide or suggest which CPG needs alternation.

After the presentation of the first version of the ‘bridging’ CPG, the focus group had some input for the actual functionality of the CDSS. A clear majority of the focus group participants (five or more) addressed the need for an integration with the Personal Health Records (EPD) or at least an import of patient data from EPD, which also should eliminate the overlap between different CPGs.

One participant proclaimed that the CDSS would result in ‘cookbook’ medical care. This argument is in conformance with the results of a study about physicians barriers for utilizing CPGs. Cookbook medical care was labeled as a bad attitude against the CPG, showing a lack of agreement with guidelines in general (Cabana et al., 1999).

5.3 Semi-Structured Interviews

After the CDSS was refined by the research team based on the feedback acquired in the focus group session in phase two, the semi-structured interviews were conducted. With regards to the first goal, the final design of the CDSS was presented per interviewee. All interviewees provided feedback as part of the validation of the CDSS, which was processed after the third phase of data collection and analysis. The average duration of the interviews was one hour, consisting of 40 minutes for the second round of validation of the CDSS and 20 minutes for the additional topics on experiences, problems, improvements and essential functionality of the CDSS.

With regards to the second goal, four topics provided insights into the experiences and preferences of the physicians in using CPGs in a CDSS. In this subsection, we report on

our finding that was brought up or confirmed by the majority (three out of five) of the interviewees.

With regards to the first topic, the attitude of the current use of the CPGs, the majority claimed that the use of CPGs in the daily practice is an improvement of medical care. This amplifies the conclusion that CPGs are found to be successful in the Dutch clinical setting (Lugtenberg et al., 2009). The majority thought the CPGs, although improving medical care, are indistinct. They claimed this is a consequence of CPGs with a large amount of text. Also, the majority confirmed that the current CPGs are not always state-of-the-art when applied in practice.

Some improvements the participants addressed in using CPGs are discoverability, the amount of text and coverage. The majority would like to see that the discoverability of the CPGs is improved. The CPGs should be listed on the intranet, but should also be state-of-the-art when listed. Furthermore, the majority stated that large amounts of text should be prevented in CPGs, which aligns with the attitude of the use of CPGs. The majority also mentioned the need for improvement with regards to the existing amount of overlap between CPGs. Overlap in CPGs is a factor that increases the difficulty in maintaining the CPGs, because if one CPG changes, other CPGs get outdated instantly.

Next, we asked what challenges the participants would find in using a CDSS. The majority fear that the implementation of a CDSS will create a large dependency on IT. The interviewees stated that physicians do not want to be dependent on IT too much. Whether this is because of earlier failures of DSS or other IT-related influences remains unknown. Furthermore, the majority doubt the CDSS will be a user-friendly system.

Lastly, one particular property of a CDSS was deemed indispensable by the majority of the interviewees; linking to the CPGs that are available on the intranet. Such a construction will not replace how the CPG is used but merely simplify its use. We believe that this preference is caused by the low amount of trust that the interviewees have in a CDSS, specifically with regards to their requirement of state-of-the-art CPGs in the CDSS, which is not always safeguarded, even in the current paper practices at the UMCU.

6 Discussion & Conclusion

In this paper, we aimed to find an answer to the following question: “How can the available anti-clotting CPGs of the UMCU be combined into a CDSS with the aim to support decision making and increase adoption of the CDSS?” In this question, two subjects are of relevance; 1) How to combine different anti-clotting CPGs in a CDSS and 2) What do the physicians need to increase the likelihood that they will adopt the CDSS.

The data shown in section five shows that a majority of the physicians have uncertainties in the overlap of the various CPGs and the correctness when modifying versions. More

than half of the physicians indicated that large amounts of text should be avoided in CPGs. In addition, most of the physicians indicated the need for the CPGs to be available on the intranet, next to the CDSS. To merge the different anti-clotting CPGs in a CDSS, the current overlap must be eliminated and the physicians need a guarantee that the state-of-the-art versions will always be applied in the CDSS. Besides this, the CDSS needs to be available in the alignment of the current CPGs. This way, the CDSS will simplify the use of the CPGs but not replace them. From the collected and analyzed data gathered from the various CPG owners, we can conclude that the reactions towards the use of a CDSS are mostly positive. This enthusiasm shows that, despite the physician's doubts with regards to ease of use, they are open for the use of a CDSS and will be likely to adopt it, given the fact that most if not all challenges identified are overcome.

Taking a look at our study, several limitations could be identified. One limitation is the available time that was planned for the focus group and the individual interviews. With more time we probably could have delved deeper into the experiences, problems, improvements and essential functionality of a CDSS as perceived by our interviewees in more focus groups. However, this was hard to negate as the physicians stated to have meager time to participate in this kind of research projects and are needed in the UMCU most of their time. We aimed to negate this partly by interviewing the individual participants as this allowed for further data collection and validation without utilizing focus groups which allow multiple stakeholders to be available on the same time and place. Furthermore, our sample composition and sample size are limited to eight stakeholders. While we believe this is appropriate at this stage of design of a CDSS in the context of the UMCU, future research should focus on the utilization of more quantitative research methods such as surveys, using larger sample sizes to increase the generalizability of the results. Also, future stages of development should involve medical informatics specialists, which excel in extensive testing on the subject-matter as well as the decision making process by a CDSS. In this study, we included a sample of eight stakeholders, which is, according to the guidelines of Dworkin (2012), a valid amount of participants for a qualitative study. Therefore, an important note with regards to future research is that quantitative research methods are dependent on the actual implementation and (partly) adoption of the CDSS in practice. Hence, we encourage the UMCU to invest in further research projects to establish whether a CDSS contributes to the quality (in terms of efficiency and effectiveness) of healthcare.

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Propensity to Click on Suspicious Links: Impact of Gender, of Age, and of Personality Traits

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Abstract There already exists a certain, not huge, body of knowledge about impact of personality traits on susceptibility to phishing. But there is a gap when it comes specifically to phishing with links pretending to lead to deal sites. The paper analyzes if gender, age and personality traits influence such behavior. Big Five Inventory traits (extraversion, agreeableness, conscientiousness, neuroticism, openness to experience) and narcissism were used. Impact of openness to experience was significant at 0.05 level, and of narcissism 0.1 level. Significance of remaining independent variables was above 0.1. Openness to experience was linked positively linked to responsible behavior, narcissism was negatively linked.

Keywords: • Suspicious Links • Phishing • Deal Sites • Personality Traits
• Empirical Research •

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1 Introduction

Deal sites, in one form or another, exist for over two decades. They received a lot of publicity before Groupon's initial public offering. According to a recent study cited by Kotler et al. (2017), "digital coupons now outpace printed newspaper coupons 10 to 1". In other words, use of deal sites is reasonably wide-spread for hackers to also link presumably leading to deal sites for infiltration.

To the best of authors' knowledge, nobody investigated impact of personality traits on phishing that is specifically linked to deal sites. (To be more specific, Google Scholar search for the query phishing personality traits deal-sites yielded 5 results, of which none were relevant.) Google Scholar search for phishing personality traits (i.e. without the term deal sites) yielded more than 2000 results, of which (due to quickly decreasing relevance) the first 100 were checked. There were two journal articles and a few conference papers investigating impact of personality traits on phishing in general.

Pattinson et al. (2012) discovered that from Big Five Inventory personality traits, higher extraversion and higher openness to experience led to better dealing with phishing e-mails. They state that the findings are interesting because they appear to be counter-intuitive since both of these personality traits should lead people to be more trusting of others which would mean treating some phishing e-mails as genuine. But they do not cite any source that would support the link between any of the two personality traits and trust. On the contrary, our results (Sudzina, 2016a; Sudzina, 2016b) indicate a link between some of the three remaining personality traits and trust or mistrust; but extraversion and openness to experience were not linked to trust nor to mistrust (this holds not only for Big Five Inventory-10 used in the two papers but also for Big Five Inventory-44 (the instrument used by Pattinson et al. (2012)) - though the findings were not published yet).

A more comprehensive study, in a sense of using more variables than only personality traits, was conducted by Welk et al. (2015). The impact of extraversion was significant but the sign was negative when only five personality traits were included in the model, the sign was positive in the full model, and the extraversion was not significant when only five personality traits and three trust/distrust variables were included. The remaining results are unclear as the terms used to describe personality traits were anxiety, reservation, calmness, and ability to keep emotions under control. The two items measuring neuroticism are "anxious, easily upset" and "calm, emotionally stable"; they seem to cover 3 of 4 remaining personality traits mentioned by Welk et al. (2015). The remaining term - reservation - looks like the second item to measure extraversion - "reserved, quiet" (reversed scale), so even the findings for extraversion mentioned at the beginning of the paragraph possibly do not hold.

There were published a few conference papers on the topic. The most relevant - considering the research design and quality of description of source data, including data collection - is (Alseadoon, I. et al., 2012). They tested impact of Big Five Inventory

personality traits on susceptibility to phishing e-mails in two phases. In the first phase, none of the personality traits was significant. In the second phase, openness to experience was significant and extraversion was borderline significant. But the direction of the impact is not clear from the published figures; they provide S.E. in the Table 2 for these two personality traits, not parameter estimates. Alseadoon, I. et al. (2012) provide this argumentation but they do not refer to test results (parameter estimates) at all:

Openness users are those who are open to new ideas and experience. E-commerce in Saudi Arabia is just developing, which explains why these users become victims. It can be said that these openness users are enthusiastic to try and test new experiences provided on the Internet (risk takers). Extraverted users become victims because they may judge phishing emails based on their positive emotions. According to Forgas et al. (2008) users' emotions impact their ability to detect deception.

The second most relevant conference paper is (Cho, Cam & Oltramari, 2016). Although they do not describe respondents, nor what instrument was used to measure Big Five Inventory personality traits, they state that (according to their Stochastic Petri Nets model) agreeableness and neuroticism influence whether a given information is received as either trusted or distrusted. Moreover, they state that high neuroticism deteriorates decision performance under low openness and conscientiousness.

Other conference papers were theoretical and some of them proposed also a model but they did not collect data nor tested the model.

The research question is whether gender, age, extraversion, agreeableness, conscientiousness, neuroticism, openness to experience, and narcissism influence propensity to what a person would click on suspiciously advantageous offer if it led to a deal site. Big Five Inventory framework is used because it is a prevalent framework for personality traits in information systems literature (and it was the only framework used by the reviewed papers on phishing and personality traits). Adding narcissism to Big Five Inventory personality traits follows the trend in information systems literature where narcissism often proves to significantly influence dependent variables. Gender is considered because in many technology studies, men are higher and/or faster in adopting technology. This could possibly lead better understanding of technology, and possibly also to more responsible use of technology. Age is considered because respondents are university students and there could possibly be a measurable change in responsibility between 19 year old students who just started to study and older students.

The data come from the Czech Republic. Some reputable deal sites in the Czech Republic accidentally sold coupons for non-existing services. Stories about such experiences were published in Czech newspapers. So, results of the analysis could be influenced by the fact that respondents may have heard about such problems and may be more careful because

of it. Therefore, results may not apply to countries without such negatives stories, e.g. Denmark.

The rest of the paper is organized in the following way: In the next section, there is a description of data collection, and how they were analyzed. In the following section, results of the analysis are presented. The last section offers conclusions.

2 Data and Methodology

Data were collected between December 2016 and January 2017 using an on-line questionnaire. Respondents were 264 university students from the Czech Republic, of which 140 respondents indicated that they use deal sites, and 124 do not. (The analysis of use versus non-use of deal sites from this data set was published in (Sudzina & Pavliček, 2017).)

SurveyXact was used for the questionnaire. Unlike Qualtrics, it does not allow to show/hide questions based on previous answers on the same page. Therefore, the questionnaire was split into two pages and questions for deal sites users appeared on the second page. Seven respondents stopped after the first page. So, the effective sample size is 133 (43 men, 90 women; on average 20 years old).

On the second page of the on-line questionnaire, there was a question "Would you click on suspiciously advantageous offer if it led to a deal site?" and respondents were supposed to answer on a 1-5 Likert scale where 1 meant certainly yes and 5 stood certainly not. In other words, a high number corresponds to positive/responsible behavior. (Even though it is clear what behavior (which end of the scale) is more responsible, three of 133 respondents still stated that they would certainly click on the link, while 20 stated that they certainly would not.) This is the dependent variable for the model presented later in the paper.

A generalized linear model (GLM) was used. SPSS software was used for the analysis. A multivariate approach to testing was used. Parameter estimates tables from GLM were provided (instead of ANOVA-style tables) in order to be able to see signs of parameter estimates (not only p-values). The results should be equivalent to a multiple linear regression model estimates in case the dummy variable is set to 1 for male and to 0 for female. R² and R²_{adj} are provided in order to be transparent about how much a model explains though it may be significant.

Personality traits were measured using Rammstedt & John's (2007) Big Five Inventory-10, i.e. a 10-item version of the Big Five Inventory questionnaire developed by John & Srivastava (1999), and translated to Czech by Hřebíčková et al. (2016). The study by (Pattinson et al., 2012) used Big Five Inventory-44 (John & Srivastava, 1999). Alseadoon, I. et al. (2012) and Welk et al. (2015) used a 10-item Big Five Inventory instrument developed by Gosling, Rentfrow & Swann Jr. (2003) which relies more on

adjectives than Big Five Inventory-10 (Rammstedt & John, 2007). The instruction in the questionnaire was to rate "How well do the following statements describe your personality" with statements "I see myself as someone who..."

- ... is reserved,
- ... is generally trusting,
- ... tends to be lazy,
- ... is relaxed, handles stress well,
- ... has few artistic interests,
- ... is outgoing, sociable,
- ... tends to find fault with others,
- ... does a thorough job,
- ... gets nervous easily,
- ... has an active imagination

on a 1-5 Likert scale where 1 meant strongly disagree and 5 stood for strongly agree. Extraversion was calculated as an average of the 1st (reversed-scored) and the 6th answer, agreeableness as an average of the 2nd and the 7th (reversed-scored) answer, conscientiousness as an average of the 3rd (reversed-scored) and the 8th answer, neuroticism as an average of the 4th (reversed-scored) and the 9th answer, and openness to experience as an average of the 5th (reversed-scored) and the 10th answer.

Authors are aware of the new version of Big Five Inventory - Big Five Inventory-2 with 60 items (Soto & John, in press a), and of 30-item short and 15-item extra short versions (Soto & John, in press b) but there is no validated translation available yet.

Narcissism was measured right after Big Five Inventory-10 using the same instruction, with the statement

- ... is of narcissistic nature (note: narcissistic means egotistical, self-focused, vain)

The statement was adapted from The Single Item Narcissism Scale (SINS) developed and validated by Konrath, Meier & Bushman (2014). They recommend SINS for online studies.

The questionnaire contained additional questions which were not used in the analysis presented in this paper.

3 Results

The research question is if gender, age, extraversion, agreeableness, conscientiousness, neuroticism, openness to experience, and narcissism influence propensity to what a person would click on suspiciously advantageous offer if it led to a deal site. Parameter

estimates for the full model are provided in Table 1. R2 is 0.089, R2adj is 0.030 and p-value is 0.160.

Table 1: Parameter estimates for the full model

Parameter	B	Std. Error	t	Sig.	95% Confidence Interval	
					Lower Bound	Upper Bound
Intercept	4.836	1.008	4.797	.000	2.841	6.831
Age	-.060	.055	1.101	.273	-.168	.048
Extraversion	-.117	.106	1.104	.272	-.328	.093
Agreeableness	-.178	.130	1.375	.172	-.435	.078
Conscientiousness	-.039	.114	-.338	.736	-.265	.188
Neuroticism	-.105	.094	1.118	.266	-.292	.081
Openness to experience	.219	.106	2.064	.041	.009	.430
Narcissism	-.181	.096	1.880	.062	-.372	.010
[Gender=male]	-.165	.220	-.750	.455	-.600	.270

The impact of openness to experience was significant and impact of narcissism was borderline significant. The former had positive effect, the latter negative. But the model as a whole is not significant. Carlson and Wu (2012) suggest to exclude independent variables that are not significant. Parameter estimates for the reduced model are provided in Table 2. R2 is 0.051, R2adj is 0.036 and p-value is 0.034. Keeping only openness to experience in the model would worsen p-value to 0.085. A model with narcissism only would have a p-value of 0.093.

Table 2: Parameter estimates for the streamlined model

Parameter	B	Std. Error	t	Sig.	95% Confidence Interval	
					Lower Bound	Upper Bound
Intercept	3.002	.399	7.524	.000	2.212	3.791
Openness to experience	.201	.100	2.000	.048	.002	.400
Narcissism	-.167	.085	1.962	.052	-.336	.001

Signs of significant estimates stayed the same when insignificant independent variables were removed. This means that people open to experience are more likely to avoid clicking on suspiciously advantageous offers leading the deal sites, while more narcissistic people are more likely to click on suspiciously advantageous offers.

Openness to experience had also a significant and positive impact in (Pattinson et al., 2012); moreover, the same impact had also extraversion in their study. Higgins et al. (2007) linked openness to experience to IQ in students. This could possibly explain why they are less likely to click on suspiciously advantageous offers.

4 Conclusion

The aim of the research was to investigate if gender, age, extraversion, agreeableness, conscientiousness, neuroticism, openness to experience, and narcissism influence propensity to what a person would click on suspiciously advantageous offer if it led to a deal site. The findings are that people open to experience are more likely to avoid clicking on suspiciously advantageous offers leading the deal sites, while more narcissistic people are more likely to click on suspiciously advantageous offers. Impact of the remaining personality traits, gender, and age was not found to be significant.

Openness to experience was found to be linked to IQ in students (Higgins et al., 2007). This could explain more responsible behavior. In addition to that, it may be relevant to consider the extent of use deal sites. It may be possible that people open to experience visit them more or purchase from them more, i.e. they get involved with them more; therefore, they have a better understanding of them, i.e. they are more ("street"-)smart, and this could explain more responsible behavior.

Now that there is an indication of impact of narcissism on purchasing coupons as gifts, it is justifiable in future research to use more items to measure narcissism, such as Narcissistic Personality Inventory (Raskin & Terry, 1988) which is probably the most widely used measure of the narcissism and contains 40 forced-choice items, Hypersensitive Narcissism Scale (Hendin & Cheek, 1997) with 10 items or Pathological Narcissism Inventory (Pincus et al., 2009) with has 52 items. If a longer instrument is to be chosen, such as Five-Factor Narcissism Inventory (Glover et al., 2012), which contains 148 items, it may be advisable to select only certain factors.

The study was conducted in the Czech Republic where there were fraud cases - coupons for services of non-existent companies were sold on regular deal sites. So, findings are generalizable possibly only for markets with similar negative experience. Further research should establish whether the same findings hold also on markets with no reported fraud cases.

Moreover, university students as respondents are possibly more IT literate and tech savvy than the general population. Therefore, it is possible that they are more responsible when it comes to on-line behavior. It is not clear whether it brings any limitation the findings presented or not - if the current signal-to-noise ratio uncovers relationships hard to spot in the whole population (i.e. p-values are lower than they would be in a probabilistic sample), or if having more irresponsible respondents would lead to lower p-values,

possibly identifying relationships not found in the research, or if the findings would be the same.

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Do Online Travel Communities Matter? A Literature Review

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Abstract The emergence of social media has migrated consumers from peripheral stakeholders to strategic partners whose inputs are critical for successful product and service innovation. Online communities provide a platform for aggregation of consumers from diverse backgrounds; online travel communities (OTCs) have recently attracted growing interest in the information systems and tourism literature because their unofficial boundary spanning role influences consumer interest in destinations. Importantly, this literature remains largely fragmented because of conflicting findings. The present study seeks to integrate prior OTC research in order to understand the motivations and consequences (negative and positive) of OTCs, as well as interaction platforms. Among the 63 reviewed studies, psychological, social, and utilitarian motivations were identified, with both positive and negative consequences for firms and individuals. Additionally, the studies were found to employ different methodological approaches, based on distinct and heterogeneous theories. The paper concludes with some implications and directions for further research.

Keywords: • social media • OTC • psychological • social • utilitarian •

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1 Introduction

The impact of social media on various economic sectors has been widely noted in the literature (Ukpabi & Karjaluoto, 2017). To remain relevant in the competitive landscape of contemporary business, marketers must remain active on different social media platforms (Lee & Hyun, 2015). Consumers see the emergence of social media as an emancipatory platform, migrating them from their previous perceived status as peripheral stakeholders to strategic partners whose inputs are critical for successful product and service innovation (Jung, Ineson, & Green, 2013; Ukpabi & Karjaluoto, 2016). Consequently, the agglomeration into online communities of consumers sharing similar interests and values has witnessed phenomenal recent growth. Interestingly, for about 80% of consumers who participate in online communities (Leader Networks, 2016), 74% of those communities are owned by large corporations (Demand Metric, 2016), and 77% of those corporations report that online communities have significantly improved their brand exposure, awareness, and credibility (MTA, 2016). According to Kang, Tang, and Fiore (2014), consumers participate in online communities for social, psychological, hedonic, and monetary benefits; the need to meet new people, share one's feelings and access better product and service options are fundamental motivations for that participation. For instance, researchers have found that participation by professionals in online peer communities enhances research collaboration (Jamali et al., 2014). As a consequence, both firm-hosted and independently owned communities are increasing rapidly in number (Casaló, Flavián, & Guinalú, 2010a). However, online communities have also affected firms and individuals negatively through counter- and alter-brand communities, deceptive posting, lurking, and invasion of members' privacy (Cova & White, 2010; Dickinson et al. 2017).

Online travel communities (OTCs) have recently become a hot topic in the tourism literature because they unofficially occupy a boundary spanning role, so influencing consumer interest in destinations (Cova & White, 2010). As tourism is a hedonic experience that cannot be comprehended prior to consumption, consumers rely on the advice and experiences of others concerning the best travel decisions. A thorough search of the wider literature identified only one review study of online communities (Lee, Vogel, & Limayem, 2003), with none in the OTC research. On that basis, the present systematic literature review has a number of objectives: first, to understand travelers' motivations for participation in OTC; second, to understand the consequences, at both firm and individual level, of OTC participation; third, to understand the contexts and platforms through which OTC interactivity is fostered; and finally, to provide a conceptual framework that will schematically encapsulate the activities of OTCs. Against this backdrop, the study contributes to the literature by providing a solid platform that integrates the fragmented studies in this research stream. This represents a useful tool for subsequent studies (Okoli & Schabram, 2010), as managers in tourism and destination marketing organizations will also find the concepts and arguments adduced here useful as levers to optimize the value of OTCs for their firms. The rest of the paper is structured as follows. Section 2 discusses the background to OTCs; section 3 describes the research

methodology, and section 4 discusses the results. In conclusion, section 5 discusses the implications of the findings and the study's wider contribution.

2 Background: Online Travel Communities

OTCs can be defined as “groups of people trying to achieve goals, with similar interests, and interested in building relationships, making transactions, and engaging in fantasy, governed by rules and using new information technology as the means” (Wu, Xiao & Wu, 2016, p.2). Development and acceptance of IT means that tourism has undergone continuous transformation, and OTCs attract travelers through reviews and recommendations on platforms such as TripAdvisor, Fodor, Qunar, virtual tourist and Lonely Planet (Wang et al., 2016). Although better understanding is needed, it is known that people join online communities for several reasons: to share views on products; to obtain valuable information; and to create, enhance and sustain social ties between online members (Lee & Hyun, 2016a).

In short, consumers join OTCs for psychological, social, and utilitarian reasons (Kang, Tang & Fiore, 2014). OTCs offer travelers an opportunity to share their travel experiences and opinions by posting reviews. These then serve as information references for other travelers, providing valuable information about points of interest (POIs) (e.g., environmental or landscape attractions), gastronomy, weather forecasts, news and safety bulletins. However, there is also a negative side to this increased information sharing within online communities; as reported by Wang et al. (2016), biased, non-credible, or deceptive information can be very challenging for travelers seeking reliable advice. A further problem is that a member of an OTC may be a lurker: someone who does not participate or contribute to any discussion but only reads and reaps the community's ideas by becoming a part of that community (Seraj, 2012). Additionally, in their evaluation of technological modus operandi and social motivations for membership in 11 OTCs, Dippelreiter et al. (2008) found that although most of the communities are integrating new technologies, some still lack integrative emerging technologies such as SSL encryption and hashed user-id security features. OTCs also need to improve personalized on-trip services to members.

3 Research Methodology

3.1 Literature Search and Selection

To conduct the literature search, we first defined key terms for the study, which included online tourism community, virtual community in tourism, tourist online community, Web 2.0 enabled community in tourism, virtual space in tourism, and social media community in tourism. Given the uniqueness of the present study and the need to capture as many relevant articles as possible, we followed Shaikh and Karjaluoto's (2015) method of combining horizontal search on Google Scholar and vertical search using databases such as Science Direct, SAGE, Wiley, Springer, Emerald, JSTOR, IEEE, Taylor & Francis,

and Inderscience. We further extended our search to ACM, ABI/INFORM, SCOPUS, and Palgrave, yielding a large initial number of studies. To reduce the number of studies to a manageable size, the inclusion criteria were confined to journal articles, conference papers, and relevant PhD dissertations published between 2005 and 2016. In total, 63 studies were finally selected, comprising 58 journal articles, 2 conference papers, 2 PhD dissertations, and 1 research-in-progress.

4 Results

4.1 Statistics of Findings

Geographically, the highest number of publications came from the USA, followed by countries in the European bloc (among which Spain contributed most), and then the East Asian bloc (China, Taiwan, and Hong Kong). Most of the studies were published in 2016 while 2005, 2008 and 2009 each returned the same number of publications (4), with none in 2006 (Figure 1). The most frequently used theory was the technology acceptance model (TAM). However, in spite of the extensions to TAM2 (Venkatesh and Davis, 2000) and TAM3 (Venkatesh and Bala, 2008), all but one study utilized the original TAM. Other theories included social identity theory, flow theory, expectation-confirmation theory, situational strength theory, and interpersonal relationship theory, and some studies used a combination of theories (e.g., Ku, 2014), see Table 1. A majority of studies adopted a hybrid model to characterize use of OTCs, integrating different variables to create a model. (The table containing the analysed studies can be forwarded on request).

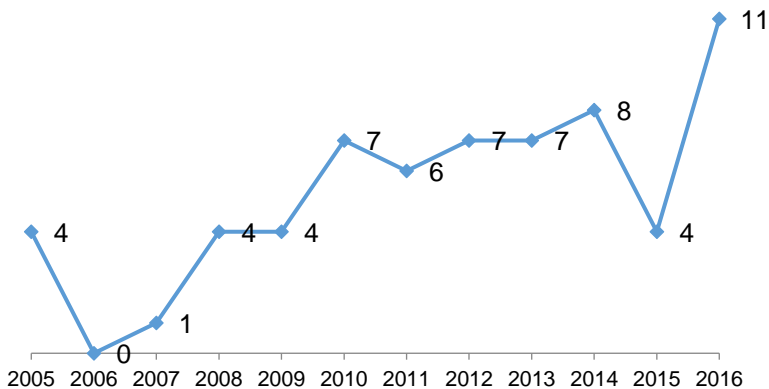


Figure 1: Year-wise distribution of studies

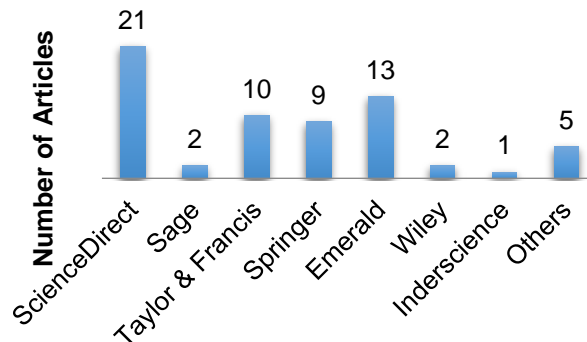


Figure 2: Articles by database

Table 1: Theoretical foundations of prior OTC studies

Theory	Studies
Technology acceptance model 1 (TAM1)	Casaló, Flavián & Guinalú, (2010a); Munoz-Leiva et al. (2012); Ku (2011); Lin (2007); Casaló, Flavián & Guinalú (2011)
Technology acceptance model 2 (TAM2)	Ting, Ting & Hsiao (2014)
Social identity theory (SIT)	Ku (2011); Lee (2005)
Flow theory (FT)	Wu & Chang (2005);
Source credibility	Lee, Law & Murphy (2011); Wang et al. (2016);
Expectation-disconfirmation theory (EDT)	Casaló, Flavián, & Guinalú (2011); Stepchenkova, Mills, & Jiang (2005)
Affordance	Cabiddu, Carlo, & Piccoli (2014)
Relationship marketing/Trust/Customer loyalty	Jung, Ineson, & Green (2013); Kim, Chung & Lee (2011)
Beliefs/Attitude	Elliot, Li & Choi (2013); Sparks, Perkins & Buckley (2013)
Situational strength theory (SST)	Hsu & Yen (2016)
Stimulus organism response model	Jeon, Jang & Barrett (2016)

Figure 3 shows the percentage frequency of the various methodological approaches. Among the quantitative studies, survey administration and retrieval were performed primarily through the different online communities and used structural equation modeling as the main analytical tool. However, some of these studies (e.g., Wang et al., 2016) adopted a big data approach, analyzing the credibility of reviews in TripAdvisor and Qunar. While a few of the qualitative studies used face-to-face structured interviews, a majority adopted a netnographic approach; netnography is a qualitative, exploratory,

online version of ethnographic research that explores cyberculture and behavior (Seraj, 2012; Rokka & Moisander, 2009).

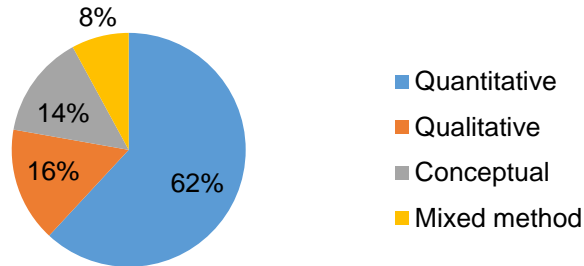


Figure 3: Methodologies used in the selected studies

4.2 Motivations for Joining Online Travel Communities

4.2.1 Psychological motivations

User involvement—that is, the degree of interest in a piece of technology—has been studied across many information systems. In OTC, Wu, Xiao, and Wu (2016) examined the relationship between breadth and depth of involvement and members' loyalty. They argued that depth of involvement exposes the individual to other activities in the OTC that increase flow experiences, pleasure, satisfaction, and fun. According to Elliot, Li, and Choi (2013), members' satisfaction increases site stickiness, which also influences transaction intention. However, in evaluating customer purchase involvement and OTC website design, Sanchez-Franco and Rondan-Cataluña (2010) suggested that while OTC website aesthetics and usability increase satisfaction, these effects are moderated by purchase involvement, and level of involvement influences members' perceptions of the usefulness of OTC websites. Another important psychological factor for OTC membership is escapism. As argued by Lee and Hyun (2015, p. 435), social, family, or romantic loneliness drives peer identification in OTCs; in other words, involvement in OTC activities is primarily a means of overcoming loneliness. Members experience a sense of fulfilment and satisfaction when OTC managers create additional platforms to enhance peer interaction through services like meeting a new companion through a certain travel product, forming a virtual family based on a particular travel view, and talking with a romantic partner about a certain travel product. The conceptual framework in Figure 4 summarizes motivations for participation, the range of OTC contexts, interaction platforms, and consequences (including dark side).

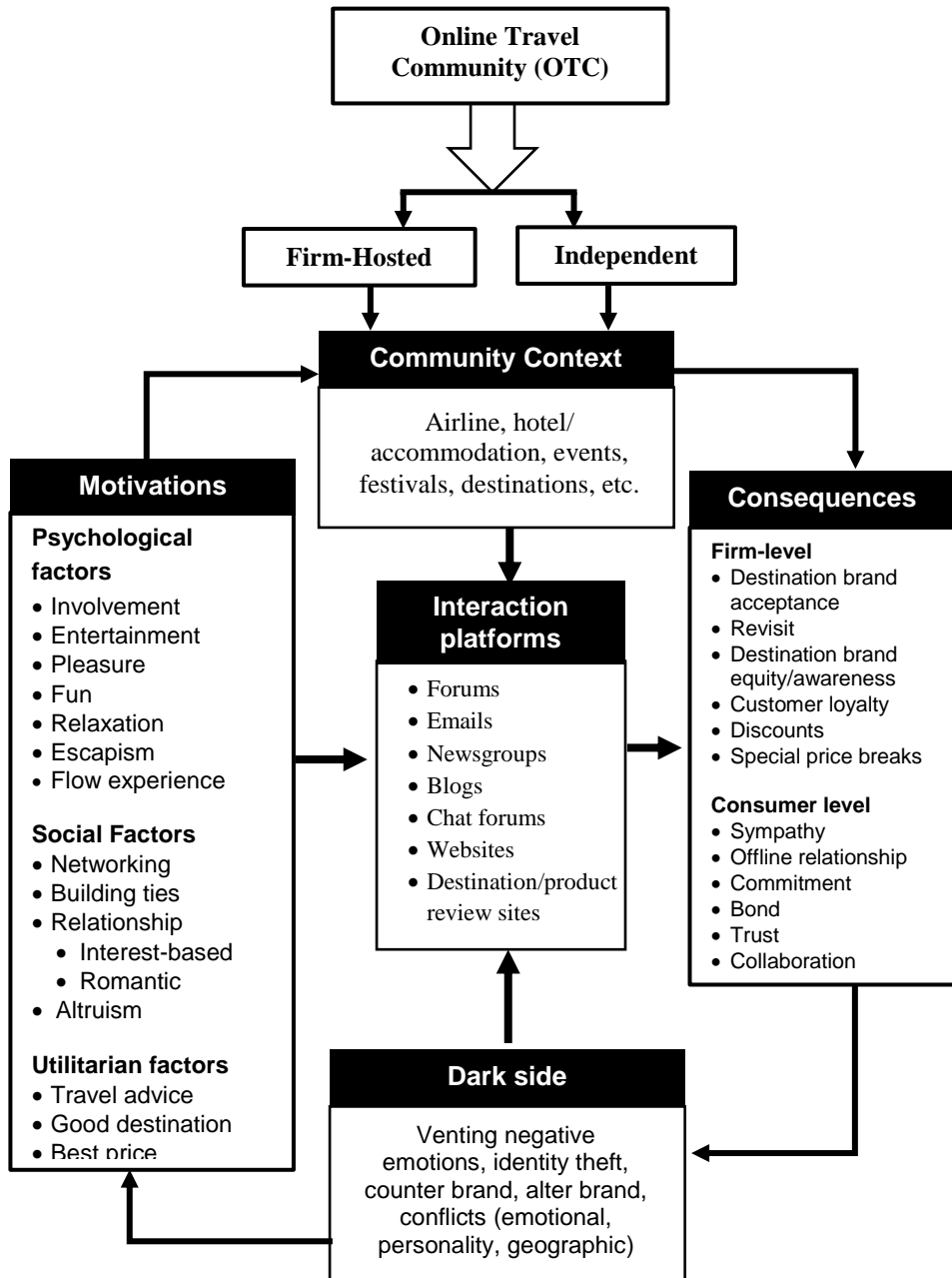


Figure 4: Motivations and consequences of online travel community participation

4.2.2 Social Motivations

Self-expression is an innate human attribute, and participation in OTCs is driven by the individual's desire for self-expression (Wang, 2016). For this reason, members assign greater importance to the transmission of information than to its reception. Investigating the antecedents and moderators of members' social satisfaction in OTCs, Yang, Zhang, and Gallagher (2016) identified entertainment, social interaction, and reciprocity as predictors of satisfaction. To enhance members' interactivity, then, OTC managers should incorporate entertaining features and activities that will maintain and strengthen members' social ties, whether online or offline. Luo and Huang (2016) proposed that OTC participation is driven by functional, social, psychological, and recreational motives, and that most people join online communities because of the social desire to make more friends. These findings challenge Vogt and Fesenmaier's (1998) argument that functional needs are seen to be the most important influence on information search. Finally, member reputation, built through exotic profiles shared on members' pages, influences evaluations of similarity and community that often lead to bonding, offline interaction, and enduring relationships (Kunz & Seshadri, 2015).

4.2.3 Utilitarian motivations

The utilitarian approach asserts that a morally correct action is one that provides the greatest benefits over harms for every individual (Santa Clara University, 2017). Chung and Buhalis (2008) argued that, of the three motivations for OTC participation, information acquisition most strongly influences participation and attitude toward the OTC. For this reason, information such as best price, service quality, best destination, and safety are the most common search criteria among travelers. In some cases, OTCs offer specific utilitarian services that increase subscription to its membership. For instance, Luo and Huang (2016) reported that, aside from socio-psychological motivations, participation in couch-surfing OTCs is driven by the utilitarian drive for recreation; those who subscribe for couch-surfing believe that the community has specialists with the requisite skills to ensure that their recreational needs are met. Jeon, Jang, and Barrett (2016) suggested that utilitarian value and online trust mediate the relationship between website interactivity and repurchase intention. Conversely, the importance of utilitarian motivation for OTC participation was challenged by Kang, Tang, and Fiore (2014), who contended that OTC participation on Facebook fan pages was largely driven by hedonic and socio-psychological benefits while functional and monetary benefits had no impact on participation.

4.3 Contexts and Interaction Platforms

Our systematic review also revealed different platforms of interaction among community members (Table 2). These include chatrooms, forums, newsgroups, blogs, websites, and review sites. However, the choice of platform depends on one's motive (psychological, social, utilitarian) for participation. For instance, Facebook fan page members are likely

to visit Facebook fan pages of restaurants when they gain socio-psychological and hedonic benefits from such visits (Kang, Tang, & Fiore, 2014). To increase visit to their fan pages, then, restaurants should constantly upload content that appeals to the hedonic instincts, such as games or live streaming videos of music and current events that will facilitate real-time interactions among members. Additionally, members who use blogs and websites to share their experiences are motivated by communal feelings, unlike the sense of self-recognition that motivates the sharing of experiences on Twitter (Munar & Jacobsen, 2014).

Table 2: Contexts and interaction platforms

Interaction platform	Context	Author
Facebook	Hedonic instincts: games, live streaming videos	Kang, Tang, & Fiore, 2014
Blogs	Communal feelings	Munar & Jacobsen, 2014
Websites	Communal feelings	Munar & Jacobsen, 2014
E-mail	Togetherness, romantic bonding	Lee & Hyun, 2015
Chatroom/forums	Travel experiences	Lee & Hyun, 2016 ^b

It is also argued that the use of e-mail as an interaction platform is fundamental for OTC managers seeking to foster social, friendly, and romantic togetherness among community members (Lee & Hyun, 2015). E-mail facilitates close-knit interactions, where members can communicate freely about private issues in a way that may be more difficult on open platforms. However, to sustain OTCs, forums and chatrooms are also necessary, where members freely share travel experiences that will assist others in making travel decisions (Lee & Hyun, 2016b). In summary, members see the OTC as an attraction where they can learn from the experiences of other members, reducing the time taken to search other sources for information about a destination.

4.4 Consequences of Online Travel Communities

4.4.1 Negative effects

Studies of online social relationships report negative effects such as extreme verbal inhibition and aggression, bullying, denigration, privacy issues, and lurking (Kim & Raja, 1991; Weber, 2011). The present systematic review revealed both firm- and individual-related negative effects of OTCs. For instance, Cova and White (2010, p. 264), suggested that firm-related negative effects of OTCs have led to the emergence of counter-brand communities—“a phenomenon of aggregation against a company that manages the brand and which leads to the creation of competing brands by members of the community”—and alter-brand communities—“a phenomenon of aggregation around not-for-profit projects that nevertheless creates a brand that can compete with the brands of certain companies.” Members of these alien communities are former adherents of a brand who have moved away because of their frustration with the firm and float activities and

programs parallel to the brand, aimed at damaging its reputation. In terms of individual-related negative effects, we also identified socio-psychological deviant behaviors that engender repulsive reactions from other members of the OTC. For instance, complaints of bullying and posting of irrelevant topics (Stepchenkova, Mills, & Jiang, 2005) and lurking (Dickinson et al. 2017) are common in OTCs. As argued by Ruiz-Mafe, Tronch, and Sanz-Blas (2016), these negative emotions constitute psychological, social, and privacy risks, and OTC managers should incorporate technologies to curb any such deviant behaviors.

4.4.2 Positive effects

Similarly, positive effects of OTC membership are observed at both firm and individual level, including increased brand awareness, functional brand image, brand use, and visit intention (Casaló, Flavián, and Guinalú, 2010b). Lee and Hyun (2016b) argued that trust is a fundamental driver of membership stickiness, leading eventually to loyalty. To promote loyalty, managers should ensure navigation functionality, security, and privacy protection (Kim, Chung, & Lee, 2011). Trust in the community also fosters a sense of belonging and sharing of emotions and experiences; in most cases, such relationships transfer to the offline world (Luo & Zhang, 2016), ending in some cases in strong bonds such as romantic affairs (Lee & Hyun, 2015).

5 Discussion

The aim of the present study was to elucidate the motivations and consequences of OTC participation through a systematic review of existing studies. A thorough and rigorous literature search yielded 63 studies, comprising journal articles, conference papers, and PhD dissertations. Through OTCs, tourists assume the status of destination evangelists, whose gospels about destinations are believed and trusted more than marketers' messages. Both firm-hosted and independent OTCs promote a range of activities that engender agglomeration of membership to a critical mass, which is seen as an antecedent of success for OTCs (Wang, Yu, & Fesenmaier, 2002). Interestingly, the threat of OTCs emanates from the question of brand ownership, as the emergence of brand communities has shifted brands from private control to publicly socialized phenomena (Cova & White, 2010). By taking an interest in and promoting the activities of OTCs, tourism firms serve a boundary spanning role, with concomitant favorable effects on destination image and visit intention (Casaló, Flavián, & Guinalú, 2010b).

Our review revealed three main motivations for participation in OTCs: psychological, social, and utilitarian. Psychologically, participation in OTCs is motivated by escapism; those seeking travel advice from OTCs do so as an escape from social, family, or romantic loneliness (Lee & Hyun, 2015). Additionally, as an individual stays longer in the OTC, they are more likely to continue (Zhao, Stylianou, & Zheng, 2013), increasing flow experience, enjoyment, and involvement (Wu, Xiao & Wu, 2016). As the social desire to forge ties and bond with others also influences OTC participation, interactivity is a key

factor in members' flow experiences and sense of belonging through knowledge sharing, community promotion, and offline activities (Wu & Chang, 2005; Qu & Lee, 2011). Additionally, Arenas-Gaitan, Rondan-Cataluna, and Ramirez-Correa (2013) argued that members assign greater importance to the transmission of information than to its reception, as a platform for highlighting and maintaining social status. Finally, information acquisition for best travel decisions, product purchase, and service quality evaluation represent utilitarian motives for participation in OTCs (Chung & Buhalis, 2008), as website interactivity is the cornerstone of members' functional satisfaction.

5.1 Contributions of the Study

Our study contributes to existing knowledge in a number of ways. First, no previous literature review has focused on OTCs. Studies of OTCs have followed different trajectories, with no coherent integration, resulting in disparate and in most cases conflicting findings that resist meaningful interpretation by scholars and managers. This systematic review provides a solid platform that integrates and aggregates these fragmented and disparate studies, offering a useful tool for subsequent studies in this area. Second, by identifying motivations for OTC participation and its positive and negative consequences, both at firm level and for individuals, our study extends prior research on online communities (Cova & White, 2010). Additionally, by explicating the interaction platforms and contexts of OTCs and the arguments adduced herein, this study offers destination managers levers for optimizing the value of OTCs to their firm. Finally, from our synthesis of prior studies and findings, we conclude that online travel communities do indeed matter, and that tourism and destination marketing organizations neglect their strategic importance at their own peril.

5.2 Limitations of the Study and Future Research Direction

One of the present study's limitations is that the data obtained were restricted by date (2005–2016). Future research might usefully increase the sample size by including relevant articles published before 2005. It is also acknowledged that additional factors beyond those investigated here also influence participation in online communities, and further study should more fully investigate these other factors. Finally, extraction and analysis was conducted manually here, which may exclude relevant studies, and automated extraction and analysis should be utilized in future research of this kind.

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Cultural Values Inherent in the Design of Social Media Platforms: A Case Study of WeChat

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Abstract Recently, there has been a tremendous rise in the growth of social media platforms all over the world. Most social media platforms are created for worldwide consumption and it is usually a significant challenge to develop these platforms for users from various cultural backgrounds. While culturally centric user behaviour of social media platforms has been well-documented, the cultural values inherent within the design of these platforms has not been thoroughly explored. This study proposes a conceptual cultural values model to examine the cultural characteristics inherent within WeChat, a Chinese social media platform. We use a research model based on Chinese cultural values to validate the model for the full scale study.

Keywords: • Social Media • Cultural Values • China • Design •

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1 Introduction

While many social media platforms are created for worldwide consumption, it is usually a significant challenge to develop these platforms for users from various cultural backgrounds (Hoehle, Zhang, & Venkatesh, 2015). This is increasingly important as the use of a social media platforms often re-flects the cultural values of the user (Chu & Choi, 2010; Qiu, Lin, & Leung, 2013). While there have been quite a few papers recently published that examine a user-centred approach i.e. how cultural contexts shape social media use (Gan, 2017; Y. Kim, Sohn, & Choi, 2011), there are fewer studies that examine the influence of cultural values on social media platform design. A study by Van Belleghem (2011) highlights the differences in social media penetration between Western European countries and others such as India and Brazil. Together with Gong, L. Stump, and G. Li (2014) they conclude that the differences in diffusion of social media across countries highlights the need for global e-marketers to appreciate why people in a particular country may be more receptive to and prone to adopt online social media than people in other countries.

This paper attends to this research agenda by reflecting on the underlying cultural values that motivate the design of a Chinese social media platform, WeChat. The exploration of cultural values inherent in the design of social media platforms is motivated by Aral, Dellarocas, and Godes (2013) and Kane, Alavi, Labianca, and Borgatti (2014). Both set of researchers present research frame-works and research agendas to encourage scholars to explore the impacts social media has on or-ganisations and society. Features built into social media platforms either enable or constrain user behaviour, while providing the building blocks to allow interactions of social processes. The design of social media platforms is important to understand because they enable interactions of social pro-cesses and culture that affect the fabric of society (Aral et al., 2013).

In the current research in progress paper, our goal is to explore the cultural values inherent in a Chinese based social media platforms using WeChat as an example. While the idea that culture is entwined in the design of information systems and applications is not new (Reinecke & Bernstein, 2013), it is an area that is understudied, especially in the Chinese context. Therefore, the research question for this study is: what are the cultural values inherent in the design of social media plat-forms? WeChat is a mobile instant text and voice messaging communication service and has be-come an important social media platform in China. Because social media such as Facebook, YouTube, and Twitter are blocked in China, WeChat has been specifically created based on im-portant Chinese cultural elements. Lin (2013) asserts that in essence, cultural values represent the most basic and core beliefs of a society, and these beliefs largely influence our communication pat-terns. Hence, culture can potentially play a significant role in the creation of social media platforms, such as WeChat.

Research indicates that the most important of Hofstede's dimensions for distinguishing among na-tional cultures, is collectivism-individualism (Hofstede & Hofstede, 2005; U.

E. Kim, Triandis, Kâğitçibaşı, Choi, & Yoon, 1994; Triandis & Trafimow, 2001), especially in the context of social media platforms (Chau, 2008). In this paper we use this dimension as a starting point to explore the particular values inherent in Chinese culture that are in turn reflected in the design of WeChat. To this end, we begin by proposing a model which encapsulates one of the key Chinese cultural values – Collectivism – and then use this model to evaluate key features of the WeChat application.

This paper serves as the first step of the research process by building the model and providing a preliminary implementation of it. The paper is structured as follows. Firstly we examine WeChat and Chinese cultural values and present our proposed research model. Next we apply our proposed model to a social media platform called WeChat. Finally we conclude with our limitations and suggestions for future work.

2 Social Media and WeChat

2.1 Social Media

Social media provides a platform for different social groups and communicate and exchange information (Cao, Lu, Dong, Tang, & Li, 2013). SNS is defined as a web-based software application that helps users to connect and socialize with friends, family members, business partners or other individuals (Gnyawali, Fan, & Penner, 2010). Features and functionality designed into social media affect how users interact, coordinate and form relationship networks (McKenna, Vodanovich, & Fan, 2016).

There are different types of social media platforms, which provide businesses with many types of interactive communication methods (Rishika, Kumar, Janakiraman, & Bezawada, 2013). Social media, text and instant messaging applications, blogs, wikis and other web forums are growing as a means of supporting additional, often critical and accurate information within the public sphere (Sutton, Palen, & Shklovski, 2008). Social media provides a platform that allows users to communicate news and information to others as an alternative form of communication such as television, radio, and print (McKenna et al., 2016).

2.2 WeChat

Chinese use of social media is increasing faster than the rest of the world. Chinese consumers tend to consider products or services if they see them mentioned on a social media site. Because social media such as Facebook, YouTube, and Twitter are blocked in China (Lien & Cao, 2014), WeChat is one that marketers could use to directly communicate with their Chinese audience. WeChat is the most widely used social networking service in China and has become an important social media platform for computer-mediated communication (Gao & Zhang, 2013).

The WeChat messaging application is developed by Tencent in China. It is reported that WeChat now delivers more than 1 billion messages per day and that WeChat has attracted more than 700 million users within 2 years of its initial launch (Custer, 2016). WeChat includes regular communication features such as text messages, voice messages, audio and video calls, and chat groups; common SNS features such as friending, posts/comments, Moments (like Facebook news-feed); and novel social features such as Shake, People Nearby, Subscribe, Red Packet, amongst others. The Great Firewall of China (Bamman, O'Connor, & Smith, 2012; Deibert, Palfrey, Rohozinski, Zittrain, & Stein, 2008) plays an inherent part of the WeChat functionality. Similar to practices on Weibo, Baidu and other social media, WeChat reserves the right to restrict particular search terms and deletes messages, threads and groups that contravene strict Chinese protocol (Bamman et al., 2012).

3 Chinese Values in a Social Context

Traditionally speaking, Eastern cultures such as China, are collectivistic. They value family, friends and their groups over self. Members of Eastern cultures tend to have fewer, closer and more enduring friendships than members of Western cultures. Collectivism in Asian societies is maintained through a general value placed on social obligations and commitments (Li & Wright, 2000; Noronha, 2002) and familial ties (Sui Pheng & Leong, 2001).

While, Hofstede, and Trompenaars, have their critics (with Trompenaars significantly criticised by Hofstede) (see (Froholt & Knudsen, 2007; Michael D Myers & Tan, 2003)). Criticisms are mainly focused around the fact that there is no such thing as a 'national' cultural identity, and that the cultural dimensions are formulated from a Western perspective. There is however, many countries where the major cultural group is such a dominating factor that, nationally, cultural values do have a national cultural identity, albeit with cultural sub-groups within that national identity. With regard to Hofstede and Trompenaars having a Western viewpoint, in the words of Hampden-Turner and Trompenaars themselves (1997, p. 149): "...social science methodology is not (emphasis added) culture free. There is no neutral point 'above' culture from which to view the universe. It follows that many different ways of viewing culture are legitimate" We look beyond these critics and evaluate Chinese values of collectivism in cultural dimensions which may bring valuable insights in terms of explaining behaviours, in particular the designers' perspective, which has been largely over-looked.

Subsequently, this section is going to develop a framework that assembles Chinese cultural attributes and centralising Chinese collectivistic culture, this is based primarily on Hofstede's (Hofstede & Bond, 1984; Hofstede & Hofstede, 2005) work. This framework helps to explain the various inter-related cultural attributes that inherent in the design of Chinese social media platform.

The social hierarchy as a result of the high power distance in China (Hofstede & Bond, 1984) leads to a strong respect for authority which is evident among Chinese daily practices (Yau, 1988). In a group orientated society, the social hierarchy and respect for authority of the interpersonal relations and the society (Bond & Hwang, 1986; Moise, 2013) is paramount. This cultural value has been largely involved with other cultural values in the discussion of interpersonal relationship in the Chinese context.

Guanxi as a Chinese cultural value has been broadly discussed in the investigations of Chinese in-terpersonal relationships in business, society and organization (Buttery & Wong, 1999; Wong & Chan, 1999; Wong & Tam, 2000). This attribute also is a key cultural factor that determines Chinese interpersonal behavior. To build up and maintain a good ‘guanxi’ helps to achieve positive group dynamics and strengthen social ties.

Compared with other cultural values, the value of keqi tends to provide a guideline of practice in interpersonal relationships. ‘keqi’, refer to ‘well-manner politeness’ (Yao, 1983), which is a personal attribute as well as an embodiment of harmony in Chinese communication to keep a courteous dis-tance with an acquaintance. Chen (Chen, 2013) argues that the keqi way of communication is the way to sustain the harmonious relationship.

4 Research Methodology

This paper is framed within the methodological stance of a case study (Miles & Huberman, 1994) which is useful for investigating contemporary phenomena and their context (M. D Myers, 2013; Yin, 2015). The proposed model in this article (Figure 1) is adapted from two existing models (Mok & DeFranco, 2000; Yau, 1988). This is the starting point of this research, this model centralizes the con-cept of collectivism and suggests a lens from which Chinese culture values can be understood in terms of specific cultural attributes of keqi, guanxi, and respect for authority. These three notions understand the collectivism from interpersonal relations, social hierarchy and harmony-maintenances. This model is designed to be used to provide an understanding of the cultural values inherent in the design of Chinese social media platform.

The first step of the research process is presented in the next section, where the authors analyse existing features of WeChat alongside Chinese cultural values. This model can then be used to fur-ther explore the design of the WeChat application. Data will be collected through interviews with designers and developers of WeChat. We will employ a snowballing interview technique which is common in qualitative research (Biernacki & Waldorf, 1981). One of the key problems of snowball-ing as identified by Biernacki and Waldorf is finding participants and starting a referral chain. We can overcome this problem because one of the authors has personal connections to employees at Ten-cent (the creators of WeChat). A second problem is the verifying of potential respondents. This problem can be solved by asking the respondents to only refer other participants for interview if they meet the research criteria we have designed. The interview questions

will be based on the cultural elements discussed earlier and presented in Figure 1 within the context of application de-sign. We aim to have at least 5 interviews, and will continue interviewing until saturation has been reached, should more participants be available.

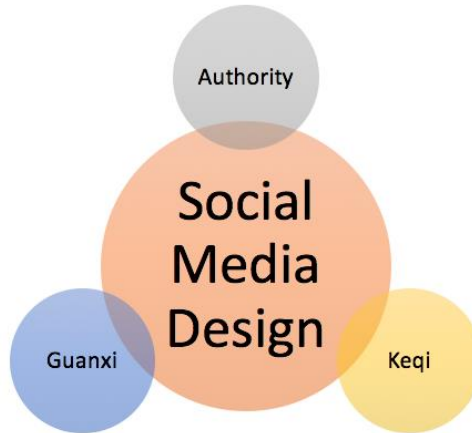


Figure 1: Chinese Cultural Value Model

To triangulate (M. D Myers, 2013) the data collected from our interviews, we will also consult documentary sources such as design specifications and screenshots of the WeChat design. All data will be collected in Chinese and translated into English by the Chinese speaking author. Data Analysis will use thematic analysis (Saldaña, 2009) to identify common themes and ideas emerging from the data.

5 Preliminary Results

In this section, we present preliminary results from our analysis of WeChat features, which are based on the Chinese culture elements presented above, and the proposed model in Figure 1. This will help us formulate a basis for our interviews with designers and users of this platform in the next step of the research.

Table 1: Features and Cultural Attributes

WeChat Feature	Respect for Authority	Guanxi	Keqi
Shake (Chatting with random users who shaking their phones at the same time)		✓	
People Nearby		✓	
Subscribe to celebrities or newsletters	✓		
Red Packet (money transactions)		✓	
Moments (Social Networking Functions)			✓

A feature that demonstrates the cultural attribute of Respect for Authority is the Subscribe functionality which enables users to subscribe to a celebrity or to newsletters. The owner of the account has the absolute right to choose and decide what comments to put on under the post. In addition, the creator of a chat group who assembles the group chat has the power to dissolve group, whilst other chat group members can only join or exit the chat group.

The Chinese cultural attribute of guanxi can include both the creation of new ties as well as the strengthening of existing ties with people. This attribute is reflected in the features of Shake and People Nearby which spontaneously match people with strangers virtually. Through this feature, WeChat allows people to form instrumental ties with strangers. In addition, Holmes, Balnaves, and Wang (2015) explore the recently introduced feature, Red Packet. This feature digitally imitates the Chinese Lunar New Year tradition of ‘hong bao’ where elders pass money to the young to encourage prosperity and provide good blessings. The red bags themselves imply a range of expectations that do not need to be made explicit. Unlike the tradition of senior people giving to junior people, the WeChat feature encourages people to give money to anyone. Thus this feature is a way to strengthen or build up social ties – another demonstration of guanxi.

And finally, the nuanced design of moments within WeChat emulates the concept of keqi. For example, while one can post images and links for all of their friends to see and comment on, the comments are only visible if the commentators are friends with each other. This feature enables the appearance of “well-mannered politeness” by not allowing acquaintances to necessarily see each other’s comments. The need for privacy which is encapsulated in the attribute of keqi is further seen in the ability of WeChat users to restrict broadcasts to specific users.

The current design of WeChat affords the practices of these three key cultural attributes – Respect for Authority, *guanxi* and *keqi*. Hsu (Hsu, 1985) emphasizes that Chinese are social and psychologically dependent on others and have a strong group orientation; therefore, individualistic behaviour is regarded as an expense to others. For example a number of WeChat features such as Go Dutch and Group Buy further reflects this group orientation.

6 Conclusion

Research on social media platform design presents interesting opportunities to examine how platform designers can structure and influence user interaction in particular ways (Aral et al., 2013). This research can help shed light on cross-cultural differences related to social media design and will be of great value to social platform designers who are pursuing a mobility strategy targeted to a global audience. Culture is often reflected by or perceived through shared practices in a community (Chiu, Gelfand, Yamagishi, Shteynberg, & Wan, 2010; Geertz, 1973; Hofstede, 2001). Cultural differences influence communication, behaviour, and values. Asian-based social media tend to have tighter social relationships, with their practices reflecting an indirect communication style and less open self-disclosure; whereas, western based social media tend to have wider social networks, with their practices reflecting a more direct communication style and bolder self-disclosure (Cho, Jung, & Park, 2013).

While social media platforms like WeChat have a potential to modernize elements of Chinese culture, they simultaneously act as a vehicle for the reinforcement of traditional Chinese collectivist cultural values (Holmes et al., 2015). We have demonstrated in this paper how a particular social media platform, WeChat, reflects the broader shared cultural values inherent in Chinese society. Our findings do not imply that other cultures other than Chinese are unsuited for using WeChat, as the application is now becoming popular outside of China. However, as it is developed in China, there are Chinese cultural values inherent in its design. Additionally, many of its features are not available outside China. A future part of our larger study will analyse and contrast social media designs from other cultures, for example Whatsapp and Facebook, in contrast to Wechat and Weibo. However, this paper only includes the Chinese cultural aspect.

This paper has two key limitations; 1) the model proposed in this paper is conceptual and has not been thoroughly validated. Validation could be carried out via an exploratory study including interviews and focus groups with the designers, developers and marketers of Chinese social media platforms such as Tencent (the creators of WeChat) and Sina (creators of Weibo). This type of study would help us to understand the motivations for the creation of features within each platform. In addition, interviews with users of these platforms would help to determine whether or not these features help engender the cultural attributes discussed in the model. 2) In this paper we focus exclusively on the concept of collectivism, however in doing so we may overlook other important values in the Chinese culture such as the concept of Harmony (Wei & Li,

2013). In future research we could extend this study to include other concepts of Chinese culture.

In addition, we think it will be useful to explore other nuanced Chinese social media such as Ren-REN, Weibo and QQ side by side. Additionally, Moreover, we are witnessing a common social media lifecycle emerging, which can be compared to traditional product adoption and product life cycle theory (Rogers, 1976). A social media platform is developed and eventually launched; it grows, and at some point will peter out unless it innovates (Cox, 1967; Torkjazi, Rejaie, & Willinger, 2009). Aral et al. (2013) suggest that by thinking deeply about platform design platform designers have an opportunity to consider add-on features and other forms of innovation to extend a platform's functionality and usability. In its relatively short history WeChat has been able to adapt and alter their life cycle through innovation. This provides an exciting avenue of future research in to the Social Media Lifecycle.

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Success Factors for Effective Customer Interaction in Digital Sales: A Case from the Digital Investment Service Industry

RÜDIGER VON NITZSCH, DIRK BRAUN & ROGER W.H. BONNS

Abstract In the off-line world, capable sales representatives align their advisory approach with their customer's individual profile to improve the quality of the process and the likelihood of a positive outcome for both parties. However, we see a movement away from the classical advisory settings towards "omni-channel" strategies, where companies serve their customers through a combination of on-line and off-line channels. In this short paper, we undertake a first investigation of how specific characteristics in the customer profile could affect the advisory success and introduce the "OPTI-model". We illustrate the application of our model using the example of Digital Investment Services, knowing that the financial services industry is one area where "omni-channel" strategies have become highly relevant.

Keywords: • Customer interaction • omni-channel management • digital sales • digital banking • customer profile •

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1 Introduction

The market for digital financial services is moving strongly, resulting from cost-reduction ambitions of the financial service providers. Like in other industries that have developed mass-customized customer interactions and product offerings, Digital Investment Services are expected to follow suit and offer an excellent domain to test our views. For example ING Group, one of the leading banks in Europe, has clearly identified the multi- or omni-channel approach as part of their overall service concepts, and they are organizing themselves accordingly (Hamers, 2016). The community of technology innovators to support these types of interactions is growing rapidly, as is illustrated by the many so called "FinTech" start-ups (Mackenzie, 2015).

For financial services with little complexity and limited need for customers to be advised by a financial expert, many of these services have been developed and successfully implemented. However, Digital Investment Services are often restricted to the transactional part of the service (e.g., buying and selling shares) and/or monitoring current positions through dashboards. The sales and advisory part would be a next challenge in the further digitization of financial services, but in our view requires a keen understanding of the psychology behind the sales process, in particular how the sales process is adjusted based on the customer's profile.

If you ever have had interactions with sales representatives in your role as a customer, chances are that you can distinguish effective approaches that fit your needs from the hopeless attempts to push you to buy something. An effective sales representative is fast in recognizing the peculiarities of his potential customer and addresses these in his interaction. For instance, if the sales representative encounters a highly rational customer, he will deliver facts and refrains from the traditional "sales spiel". Is the customer uncertain about his desires, the sales representative will start by assisting the client and by identifying his primary decision criteria. If the client is highly sceptical, the sales representative's first objective should be to gain his trust. Or finally, if the customer wants to know everything there is to know about the product or service, the sales representative will need to show his professional expertise and deliver facts that matter to the customer. Experienced sales representatives not only master these different approaches, but more importantly, they have the skills to recognize when to use them by "reading" the customer in front of them.

When we shift our attention to the digital environment and the sales processes there, all of these elements are present as well. Hence, digital sales channels must go beyond product representation and recommendation and interact in such a way with the customer that he feels well taken care of. These interactions do not necessarily need to be executed by humans, as insights from the field of artificial intelligence and in particular self-learning systems show (Hill, Randolph Ford, & Farreras, 2015; Shimazu, 2001). How such systems should operate is partly a technical matter, which is beyond the scope of this article. However, it is also a challenge from a business design perspective. We need

to determine, which customer characteristics can help to determine if it is worthwhile engaging the customer, and if so, which process steps have to be adjusted and executed according to the customer profile.

In this paper we propose a model that offers four dimensions to deliver individualized interactions in digital sales settings, using the example of Digital Investment Services.

2 The OPTI Characteristics Model

Based on insights from the behavioral finance literature (e.g., Ariely, 2010; Kahneman, 2012), that studies the psychological aspects involved in making financial decisions, we have identified four different dimensions of a hypothetical customer profile. These foundations give us the conviction that it is possible in a digital setting to align the communication processes and interaction with the customer profile, similar to the sales representative and his empathy and human natural intelligence in our starting example. We refer to these dimensions as the "OPTI Characteristics" (Figure 1).

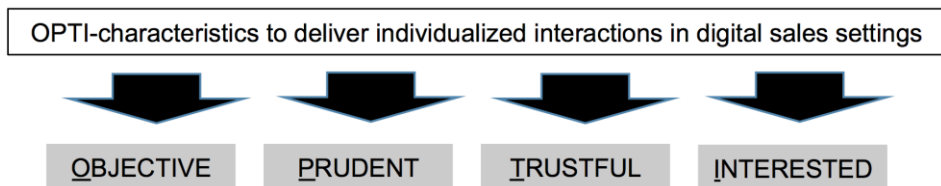


Figure 1: The OPTI Characteristics as foundations for customized customer interactions

The denotation of the respective customer specific characteristics within each of the four dimensions enables the construction of a customer specific and individual profile that forms the basis for a customized interaction: Objective, Prudence, Trustful and Interested. The next sections discuss these four characteristics in more detail, using the case example of an investment through a digital service channel. As such we present first ideas how the digital interaction for such an investment would change depending on differences in the characteristics in the customer profile.

2.1 The "OBJECTIVE" Characteristic

The dimension Objective captures the existence of rationality in the investment decisions of the customer. A maximum score in this dimension refers to a customer that does not allow any emotions to affect his decision (Kahneman & Tversky, 1979) and who has no cognitive dissonances (Cooper, 2007). He is an analytic, who only cares for factual data, which he carefully weighs before reaching his decision. On the other extreme of the Objective scale, we find the customer who makes all the classical errors known from behavioral finance (Kumar & Goyal, 2015). Examples for these are cyclical investments (Rouette & von Nitzsch, 2006) and investments in primarily domestic stock, as they provide him with a higher sense of control, yet lead him to a poor diversification and

unnecessary risk (French & Poterba, 1991). Or he shows a clear level of overconfidence and is convinced he is smarter than the market (Stotz & von Nitzsch, 2005). He is surprised, that after many transactions, he receives a smaller yield on his portfolio when compared to a passive investment on a market index (Barber & Odean, 2001).

The construction of the interaction - especially for those customers who tend to make the classical investor mistakes - needs to capture these aspects, support them transparently and deliver a sustainable added value to the customer, without robbing him of the freedom to make the final decisions himself (Sunstein, 2014). An investor who prefers cyclical investments can be informed more actively and prominently that anti-cyclical investments may have some distinct advantages (Daniel, Hirshleifer, & Subrahmanyam, 1998). Alternatively, he could be recommended to delegate more of his portfolio decisions to the system, for instance by offering a periodical rebalancing of the chosen asset allocation (von Nitzsch & Braun, 2017). In essence, all mechanisms could be applied that have become known and discussed under the term Nudging (Thaler & Sunstein, 2008). This refers to the approach that psychological behavior patterns are structurally used to steer people towards a beneficiary path for them and/or society as a whole.

2.2 The "PRUDENT" Characteristic

The Prudent characteristic captures how careful and considerate a customer is regarding the conditions that influence a financial decision, or in other words, how well he knows the necessary facts and his own preferences (Van Rooij, Lusardi, & Alessie, 2011). At the maximum of this scale we find the customer who has a complete overview of all his finances. Basically, he can articulate precisely, which investment goals he wants to achieve, while he is able to quantify his targets in relation to his risk appetite (Lusardi & Mitchell, 2014). Conversely, at the other side of the scale, customers have no or very limited insight in their financial situation. They have not yet considered which targets they want to achieve with the investment and are far from knowing which risks they are willing to take in doing so. These customers face a range of ambiguities (uncertainties about the conditions associated with the investment decision) and are feeling highly uncertain (Bossaerts, Ghirardato, Guarnaschelli, & Zame, 2010; Ellsberg, 1961).

For the interaction with customers, a correct measurement of this Prudent characteristic is very important, as customers with low prudence are quickly overwhelmed, especially in a digital setting. They are more likely to quit the interaction prematurely, especially since product-specific offers do not help them and they lack recognition that their personal circumstances are "understood" by the digital service (von Nitzsch & Braun, 2017).

In our view, future successful Digital Investment Service providers will have the appropriate tools to reduce these ambiguities. Based on the customer type, different tools can be included in the interaction, for instance to first determine the monthly available

capital for an investment. Subsequently, risks can be visualized in a graphically appealing way. This not only helps to identify the risk profile of the customer, but also provides him with more confidence in his ability to reach a sound decision, as he is structurally engaging in the relevant themes for his decision (von Nitzsch & Braun, 2017). For instance, he receives information how much money is needed for a meaningful retirement plan, the associated risks and benefits etcetera. This reduces the ambiguities and thus facilitates a decision (Van Rooij, Lusardi, & Alessie, 2012).

2.3 The "TRUSTFUL" Characteristic

The Trustful characteristic measures the fundamental trust in the digital offering. At the maximum point of the scale, customers trust their service provider and the tools and recommendations the provider delivers. They have no concerns about a lack of security or data privacy that would stop them from using the digital environment. However, if a customer does not (fully) trust the service provider, it will be difficult to envision any interaction, digital or otherwise, between them (Bettiga, Boaretto, & Chen, 2013). Besides providing incomplete data to the tool, the untrusting customer may just want to test how the tool works, without completing the actual process and coming to an investment decision.

The impact of this characteristic on the interaction is guided by the insight, that a lack of trust can be best addressed through personal contact (Fehr, 2009). This means - if at all - reverting to an off-line channel, or possibly a video-conference within the tool. Customers with a low score on Trustful should therefore not be asked to execute sensitive steps in the digital environment (Howcroft, Hewer, & Durkin, 2003). For instance, the risk profile of a customer can be determined by attractive digital tools, which would be acceptable to these customers since they do not require sensitive personal data and do not result in financial consequences (von Nitzsch & Braun, 2017).

The obvious advantage of a digital service is the size and scope of the available information as well as the determination of the customer preferences. Both elements would be difficult to achieve at a comparable level in a classical service conversation (Heinemann, 2013). Customers on the high end of the Trustful scale can be offered a fully digital interaction and they would likely experience this as added value and added flexibility, as they do not need to be bothered with scheduled meetings, travel time etc. Hybrid modes, where the representative and the customer are sitting together behind the same screen (often based on tablet technology) are getting more popular and show promising advantages for both service provider and customer (Nüesch, Alt, & Puschmann, 2015).

2.4 The "INTERESTED" Characteristic

The Interested characteristic captures both the general interest of the customer in financial topics as well as his motivation to find a good answer to a specific question. On the

extreme positive side of this scale, customers are continuously looking for comprehensive information and have the ambition to become knowledgeable on financial themes. They are willing to commit time, emotional energy and possibly monetary means to be engaged and to ensure the finances have been well taken care of (Howcroft et al., 2003). This usually results in a higher financial competence, as they already possess a lot of relevant information about the specific financial decision they are contemplating (Lusardi & Mitchell, 2014). The obvious counterpart on this scale is the customer who has absolutely no interest at all in financial themes and does not want to spend any effort on this theme.

The customer with a high score on the Interested scale will shy away from a service provider who constructs and/or manages a portfolio without any explanations and arguments. This customers demand a clear understanding why the portfolio decisions have been proposed or taken. Offers that enable the client to identify thematic focal points, such as low carbon-emission investments, provide a good fit to this customer profile. They will value periodical updates beyond the yield development that include other developments in his field of interest (von Nitzsch & Braun, 2017). Conversely, the customer who is in "don't care" mode for all these matters should not be bothered with these themes, beyond the legal requirements the service provider has to comply with as part of his "customer care obligation". It would make him less certain or at the very least he would find it annoying and it would steer him away from his well-intended service provider (Ha & Hoch, 1989).

3 Conclusion and Outlook

In this paper we focussed on Digital Investment Services and how they should aim for a level of individualization in the interaction process to fit the customer profile using digital and automated processes. This would not just deliver a custom fit from an investment portfolio perspective, but also achieve that the customer feels well taken care of during the entire interaction and service consumption. It would increase the customer engagement and identification with the product and provider, compared to current standardized digital solutions and interactions, but also the pseudo-individual interactions occurring in retail branches of financial institutions.

In particular the characteristics Prudence and Trustful indicate, that already today there is the potential and the need for a combined multi-channel approach. For instance, the actions of the customer in the digital environment when providing information can be captured to provide input for the subsequent service process. If the customer requires a lot of time to answer specific questions and/or makes several revisions, it might indicate ambiguity about that particular question and would provide the possibility to connect a representative via a different channel (voice or video connection) at that time, of course depending on the resources and service model of the provider.

Of course, we have only started to scratch the surface in providing customized Digital Investment. Future research should result in an OPTI-profiling instrument and the

associated translation to the customer profile. Also, the various technical and content components that would be needed to achieve the desired alignment of the customer interaction need to be identified and operationalized, including gaps where current technology does not yet offer solutions. This will be the focus of our next steps, in which we plan to develop such a profiling tool and implement it in a real-life Digital Investment Service.

In summary, the OPTI Characteristics are expected to help in the identification of the various archetypical customer types. Knowing their different affinities or attitudes towards the use of digital services will enable the customization of not only the products and portfolio, but also the interaction with the customer, giving them the necessary comfort to use the digital channel if and when they like, possibly in addition to the traditional channel when the situation demands it. Understanding these characteristics helps to design the Digital Investment Services of the future.

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Wearables and Wellness for the Young Elderly - Transforming Everyday Lives?

CAMILLA WALDEN & ANNA SELL

Abstract Mobile and wearable technologies have unique advantages within health and wellness. Current knowledge on wearables shows, however, that users easily abandon them after an initial use period. We wanted to investigate whether adding a social dimension to wearable use would be valuable in the young elderly age group, and investigate user experiences of wearables when introducing them to people not in the traditional target group of fitness wearables and without previous experience of wearables. In this exploratory study aimed at gaining a holistic picture to guide further research, we utilize multiple research methods to gain rich data. We found that the young elderly had a clear interest in the wearable. Introducing a social dimension to the wearable seemed beneficial as the young elderly quickly formed a both supportive and competitive relation. The social connection formed through the device appeared to be value adding for the participants and seems to at least partially address the previously identified barriers.

Keywords: • Young elderly • Third age • Wearables • Wellness • Social wellness • Physical wellness •

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1 Introduction

Mobile and wearable technologies have unique advantages within health and wellness. Wearables could be a way to help the young elderly to stay active longer and remain well. Even though wearable fitness trackers are not a new technology as such, there is evidence that they have not recently evolved to better meet the requirements of users (Harrison et al 2015).

Smartphones are prevalent among the population, but present problems regarding fitness tracking such as problems with data entry (if manual) and inaccuracy of data (if smartphone is not carried on person at all times). Wearables can solve these problems and could thus be a better choice for sustained wellness (see e.g. Amor and James 2015).

Current knowledge on wearables shows, however, that users easily abandon them after an initial use period. In a Gartner (2016) report it was found that the abandonment rate of smart watches is 29%, and 30% for fitness trackers in a study with more than 9500 participants. Gartner also found that wearable devices are not found useful enough and users easily get bored with them. The perceived value in relation to the price is not found to be compelling enough, especially in the over 45 years age group.

Current wearables only take into account the physical dimension of wellness and they are traditionally targeted mainly at the working age population and already physically active consumers. We wanted to explore (i) how adding a social dimension to wearable use would impact the wellness behaviour in the young elderly participants, and (ii) investigate attitudes towards wearables when introducing them to people not in the traditional target group of fitness wearables and without previous experience of wearables.

We use the term young elderly to describe our target group of active 60-75 year olds (Carlsson and Walden 2016). Our definition of the young elderly is similar to the concept of the third age, except with a narrower age frame. The third age is a concept used to describe the time period between retirement and actual old age, a period 25 to 30 years long (see Sadler 2006). The third age or being young elderly is understood as a period of good, active life.

Stamer (2014) defines wearable computers as any body-worn computers that are designed to provide useful services to the user while she is engaged with other tasks. Besides fitness monitors, Stamer includes in his definition e.g. MP3 players, smart watches and also smartphones, depending on how they are used. Lazar et al. (2015, pp 635-636) discuss smart devices with the definition “devices that automatically gather information about users or their environment to assist them in gaining knowledge about themselves and/or taking action”. Fernandez (2014) defines wearables in the broadest sense as including any computer devices that can be carried on person with the purpose of assisting the user. We use the term wearable in line with these definitions.

The paper is organized in the following way: after this introductory section we present a literature review of wearables and wellness in section 2. In section 3 we discuss the study design and present the participants chosen for this study. In section 4 we present the results of the study and in section 5 we discuss the findings and the implications of the study.

2 Literature review

2.1 Wearables for wellness

For a useful way to discuss wearable technologies for fitness and wellness, Ananthanarayan and Siek (2012) present a taxonomy consisting of (i) goals and users, (ii) persuasion methods, and (iii) data presentation. An example of a relevant goal is motivating physical activity. Persuasion methods belong to either self-monitoring, social influence or fun interaction. Finally, they suggest that data presentation methods are especially important in wearable devices. Regarding social influence, the authors report studies where positive motivating effects were found, but the boundary conditions of successful social interaction in this context are not clear. In line with this, Schmidt et al. (2015) discuss fitness trackers from the viewpoint of sustaining motivation for using them. They suggest that current trackers are technically sufficient in their ability to capture exercise data, but they fail in supporting users' motivation due to the data not being connected to a clear personal fitness goal.

In a small group study on teenage girls, Toscos et al. (2006) investigated the effect of forming virtual peer groups to support exercise motivation. In a post-trial questionnaire, the participants rated group performance to be the strongest method for motivating behaviour change. Engaging in virtual peer groups appears to transform exercise from a solitary self-monitoring activity to a shared experience.

Fausset et al. (2013) report on a two-week trial where older adults (61-69 years old) were given fitness wearables to use within their everyday life. Despite initial enthusiasm, only three of eight participants reported continued intention to use the technology. Inaccurate data collection lead to lowered motivation and trust in the device. Uncomfortable design and a sense of wasting time when using the device were also problems. No users reported issues with the ease of use of the devices in the trial.

Fritz et al. (2014) interviewed thirty wearable users (from their twenties to mid-60s) who had of their own volition adopted the devices. The duration of use ranged from 3- 54 months. The sample was slanted towards technology-related professions and early adopters. Results suggest that it is beneficial if the system allows support for social interaction. Fritz et al. (2014) found, in line with Fausset et al. (2013), that the accuracy of exercise data was highly important for the users; "appropriate credit for activities is essential for encouraging physical activity" (Fritz et al 2014, p. 495).

In a 10-month in-the-wild study of an activity tracker smartphone app, Gouveia et al. (2015) report that only 14% of the participants continued use of the tracker after two weeks. All of the users quit before the ten-month period was over. They found initial adoption to be correlated to the stage of behaviour change; participants who had identified a need and were preparing for an exercise-related behaviour change exhibited the highest adoption rate. Participants who were already active or in the maintenance stage of their behaviour change were much less inclined to adopt the tracker.

As high rates of abandonment seem to be the norm for activity trackers, Harrison et al. (2015) investigated barriers to use and users' workarounds to the barriers. Their participants (aged 18 to 55) reported main barriers to be related to inaccuracy, design and lack of social functionality. Interestingly, Harrison et al. note that most of these barriers were identified in research already ten years ago, suggesting that fitness wearables have not evolved significantly in this time period.

Lazar et al. (2015) also investigate reasons to abandon wearables; they conclude central reasons to be irrelevant data, too cumbersome usage and the devices not matching the participants' conceptions of themselves.

Preusse et al. (2016) suggest in a study on older adults' acceptance of activity trackers, that targeting barriers could increase their acceptance of wellness devices during the deployment-phase of adoption. Meyer et al. (2015) also investigate factors influencing the acceptance and usability of wearables.

For a recent systematic review on wearable wellness support, please see Warraich (2016).

Discontinuation of use is a clear trend in most studies on fitness wearables. Different writers suggest that sustained use might not always be a necessary goal; if behaviour change is achieved and maintained, the tracker might no longer be needed. On the other hand, there is little evidence that behaviour change is retained in the long run after discontinued use of the wearable. Wearables could play a role in sustaining healthy behaviour also after the initial behaviour change.

Users in many of the studies call for social functionality. Also frequently reported are difficulties with the accuracy and meaningfulness of the collected data. Most of the studies focus on working-age participants, but some specifically target older adults (Preusse et al. 2016, Fausset et al. 2013).

2.2 Dimensions of wellness

Wellness is a concept, which is often described to contain different dimensions. In a wellness model presented by Hettler in 1976 (National Wellness Institute 2017), six dimensions of wellness were introduced: physical, emotional, occupational, spiritual, intellectual and social. In some models, dimensions such as environmental, cultural and

climate are also included (Diener et al. 2009, Dolan et al. 2008, Helliwell 2005, May 2007). In our research we use the six dimensions most frequently mentioned by wellness researchers (for a comprehensive overview of wellness models, see Sell et al. 2017). The dimensions are interrelated to some extent, Figure 1. Physical wellness is supported by the other dimensions of wellness, and vice versa. In this research we are especially interested in the physical and social dimension.

Physical wellness is probably the most well-known dimension of wellness. The benefits of physical activities have been proven in many studies (Galloway and Jokl 2000, Wartburton et al. 2006, Penedo and Dahn 2005). Physical wellness generally refers to an individual’s physical health, physical activity level, nutrition, self-care, and vitality or longevity (Miller and Foster 2006; Brown and Alcoe 2010, Anspaugh et al. 2004).

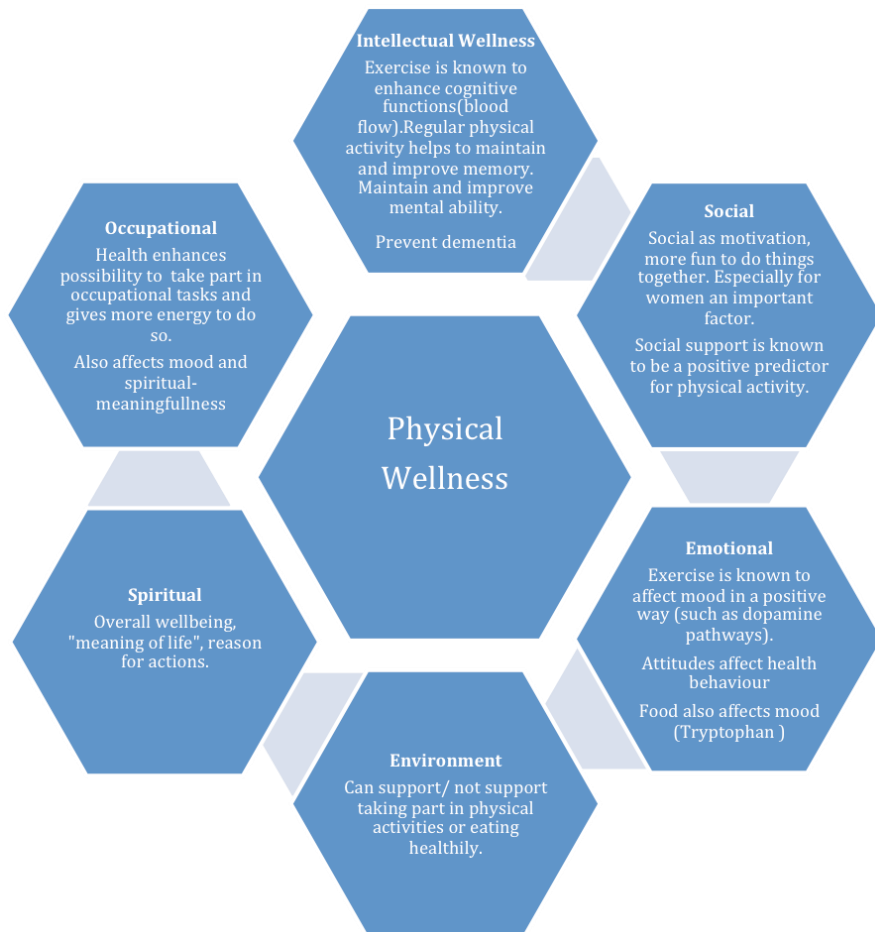


Figure 1: Dimensions of wellness

Social wellness is understood as an “appraisal of one’s circumstances and functioning in society”, components of which are e.g. social contribution – the feeling that one is a valued, contributing and important member of society, and social integration – the feeling of belonging to a community and having something in common with those within one’s social sphere (Keyes 1998, p 122).

Humans have an inbuilt need of social interaction, and deprivation of social interactions is known to be detrimental to health (Leist 2013). Loneliness is a known risk factor for the elderly, associated with a heightened risk for depression (Golden et al. 2009), Alzheimer’s disease (Wilson et al. 2007), and coronary disease (Sorkin et al. 2002) as well as an increased risk of mortality among men (Holwerda et al. 2012).

We believe that supporting social interaction and consequently social wellness through technology is possible, but the research evidence is only emerging and still scarce (see e.g. Kang 2007 [general population], Chopik 2016, Baecker et al. 2014 [elderly]). Part of our aim is to gain knowledge on how social interaction can be mediated through technology in order to maintain wellness. With social interaction we mean not only face-to-face interaction, but also e.g. interaction that can be same time / different place, different time / different place.

Physical activities are known to be related to the social dimension. Social support is known to be a positive predictor for physical activities (Troost et al. 2002). Especially for women this relationship is an important aspect (see e.g. Eyler et al. 1999).

3 Participants and study design

This is an exploratory study aiming at gaining a holistic picture to guide further research. We utilize multiple research methods to gain rich data; we employ focus groups, individual interviews, a six-week trial of the target technology divided into three two-week phases with planned interventions, and finally quantitative measurement of the participants’ activity levels collected with the Physical Activity Scale for Elderly (PASE) instrument. The PASE results are not reported in this study, as they did not help us understand the participants better.

For the study we recruited five participants, three men and two women, all between the ages of 60-75. All participants were smartphone and computer users, three of the participants also used a tablet computer. None of the participants had experience of wearables. The participants were chosen through purposive sampling with a clear definition on the desired participant profiles. We wanted participants with smartphone experience, within the age range 60 to 75 years old and both male and female.

Aron, born 1942 is a medical doctor. He is married and has a yearly income exceeding 50 000 euros. He is an active computer user and he has a smart phone. His hobbies are singing and participating in different groups, for example rotary.

Barbara, born 1946 has a bachelor's degree and was working within international business. She is married and has a yearly income between 30 000 – 40 000 euros. She is using a computer, a tablet and a smart phone on a daily basis. Her main hobby is volunteer work for the Red Cross.

Carl, born 1946 is a doctor in business administration and is working as a part-time management consultant in his own company. He is married and has a yearly income between 30 000 – 40 000 euros. He is an active computer user and he has a smart phone. He is playing tennis on a regular basis.

Doug, born 1946 has a doctoral degree in political science. He is married and his yearly income exceeds 50 000 euros. He is an active computer user and he has a smart phone. His hobby is cycling.

Ellen, born 1940 has a master's degree in education and has worked in primary education as a language teacher until retirement at age 68. She is divorced and has a yearly income between 30 000 – 40 000 euros. She uses a computer, a tablet and a smart phone. In her free time she goes to the gym, reads and does handicrafts.

For the study we had access to the fitness bracelets Fitbit Charge and Polar Loop. Both bracelets offered similar functions: a pedometer, sleep monitoring, watch, and keeping track of reaching a daily activity goal. The Fitbit allowed forming groups of users who could follow each other's activity levels and send messages to each other. The Fitbit had the possibility of vibrating alarms.

Two participants used a Polar Loop, the Fitbit Charge by the remaining three.

We divided the study into three two-week long phases:

Phase 1

The first phase of the study started in September 2015. Each of the participants was invited to the research institute individually for getting started with the study. The bracelets were set up at the institute together with the participants. The main functionalities were shown individually to the participants and possible questions were addressed. Participants were encouraged to be in touch if any questions or problems would arise.

The pilot group was asked to wear the bracelet on their non-dominant hand. They were instructed to only take the bracelet off while showering/going to the sauna /swimming or while charging it. The activity bracelets synchronized automatically with the phones, throughout the day. After two weeks, a telephone interview was made. At the same time the participants received instructions for the following two week phase of the study, phase 2.

Phase 2

The participants with the Fitbit charge activity tracker were connected with each other, so that they could follow each other's achievements on the Fitbit application. We wanted to test if this social aspect would have a motivational impact on the users. No manipulation was conducted with the Polar Loop users. After two weeks a telephone interview was again conducted. Also the participants received new instructions for the following two week phase of the study, phase 3.

Phase 3

The Fitbit Charge users were promised a free lunch, if they could exceed their steps with 5% from the previous week. All of the three participants managed to do this within the given time-frame. Polar Loop users were not manipulated. At the end of phase 3, a phone interview was conducted.

4 Findings

4.1 Practical insights

All the participants completed the six-week bracelet trial successfully and had an overall positive experience. There were some practical issues hampering the usage and usefulness of the bracelets however.

One concern shared by all participants was that they like for the wearables to measure also other kind of exercise besides steps, such as cycling, swimming and stretching. Also incidental exercise, such as lifting things or working in the garden does not get recorded.

The sleep monitoring was found useful, but not always accurate. At times, the bracelet seemed to record sleep, even if the user was awake.

The design of the bracelets themselves received some criticism. The Fitbit was difficult to attach on the arm. The attachment is not secure; the bracelet falls off occasionally, even during the night. The Loop on the other hand was difficult to adjust to the right size; to cut the bracelet and get the pins in place. The Loop attachment was also not secure and would open occasionally by itself. On both bracelets, the text on the screen was easy to see.

The information received from the bracelet was seen as enough. The participants lifted out the risk of getting too much information. Also the participants voiced that too many features (such as in smartwatches) might become confusing.

An annoyance was that when charging the wearable, it shows as inactivity on the application.

The participants felt using the bracelet to be motivating. They moved more and checked the steps regularly and made an extra effort to collect enough steps. The achievements during one day mattered more, than the overall weekly report, since the days are so different.

4.2 General observations

Even in this age group, people are not free from peer pressure. One member felt, that it is embarrassing to use a smartphone; many of her friends have not been using computers at work and thus have a skeptical attitude towards technology. This means that elderly taking into use new technology, such as a fitness bracelet, might benefit from e.g. encouragement from people who matter to the person (see e.g. technology adoption studies).

Things that restrict or hinder the participants from exercising were discussed. The fear of walking alone (for women) and not wanting to travel too far in order to be able to exercise were mentioned. The participants were also encouraged to discuss things that might restrict their friends from exercising, in order to lower inhibitions or shame associated to not exercising. Different ailments were mentioned as an obstacle. Being lazy and being too comfortable at home on the sofa were brought forward, and on the other hand that it is difficult to start something new and take the first step. Other activities might restrict participating in physical exercise, such as devoting time to taking care of grandchildren. Being worried about the way one looks might be a restriction. Also there is a worry that gym personnel or personal trainers are not necessarily knowledgeable or interested in the exercise needs of the elderly.

The focus group participants felt motivated to exercise due to the bracelets. One of the participants was not a frequent walker before the study, but reported finding the joy of being outside through the bracelet trial. The participants reported also other things which motivate them to be physically active. A dog was mentioned as a great motivator for getting outside, also alleviating the fear of walking alone mentioned by the women in the study. The feeling after exercising is motivating, as well as the physical effects of it, such as losing weight and noticing an increase in your flexibility.

One of the themes of the concluding focus group session was different campaigns to promote exercise participation. The focus group participants found benefits in being a member of some social group and doing something together. But they also identified restrictions in this; you cannot walk as fast as you would like to and you have to decide together on a suitable day and time. Virtual campaigns, where the participants are not necessarily exercising at the same time or in the same place on the other hand were criticized for allowing participants to fake that you are doing something while you are not.

The functions that the participants hoped for in a bracelet were a ‘stop snoring’-alarm and reminders. They also hoped for alerts when the users’ patterns change from the normal, such as sleeping more or less. Body temperature measurement was wished for, as well as possibility to share the data easily with others. The wearable needs to be durable and comfortable to wear in all activities, so it is not forgotten off the hand. It needs to endure swimming, sauna, dirt etc. They also hoped for a GPS function to increase their feeling of safety when moving outside.

4.3 Introducing the social dimension

Current research on fitness wearables indicates that they fail to engage users in the long run. Despite giving the user access to more accurate data on e.g. exercise and sleep than is possible through apps, but something seems to be missing. We wanted to investigate what, if any, impact including a social dimension would have. The participants in our focus group shared many common characteristics, but were not members of the same social network from before. Linking three of the participants together with the bracelet and smartphone app had some effects on their exercise behaviour. They reported experiencing positive peer pressure and elements of competition through seeing each other’s achievements. They followed their peers actively and increased their own exercise in order stay ahead of the “competition” or “not be the worst”. Also when we at phase 3 applied some external pressure through promising a reward for all participants who increased their step count with 5% or more, all respondents did reach the target, but they reported their main motivation behind it to be keeping abreast with the other participants rather than the reward. The participants also spontaneously started to send each other supportive messages.

The virtual social group enabled the participants to have the feeling of being part of a social activity, without having to deal with the practicalities of actually exercising together and losing their autonomy and independence.

5 Discussion

Based on our experience, we believe that introducing functionality to the young elderly in a sequential manner, rather than all at once, might help overcome adoption-related challenges. An overload of functions is likely to happen when introducing a new device, which might cause confusion to such a degree that satisfaction is low and the will to continue using the device is impacted.

The young elderly focus group had a clear interest in the wearable, even though they do not match the usually advertised target group.

Introducing a social dimension to the wearable seemed beneficial as the young elderly quickly formed a both supportive and competitive relation. This is a novel finding, as

previous research has not highlighted the importance of building in support for the social dimension of wellness in wearables. The social connection formed through the device appeared to be value adding for the participants. The social dimension spurred on the participants to maintain or even increase their level of physical activity, which in itself is an important finding with implications for wellness service design. It seems to at least partially address the previously identified barrier of meaningless data, as giving a social context to the users' data made it more interesting. As a consequence of this, adding a social dimension would likely aid in lowering the abandonment rate of wellness wearables.

The comparison to other users also had a direct impact on the decisions the users were making; the participants could see that their peers were ahead of them in steps and then decide to make their daily walk longer. We found it interesting that the competitiveness was so present and motivational also in this age group. It remains a challenge for future research to investigate whether it is prevalent in the young elderly, and whether it differs between cultures. The trialed devices allowed for social interaction, but we found the functions somewhat limited. With regard to the fact that the social dimension seems to be highly important for motivation, we suggest device manufacturers to put efforts into developing this dimension. For example, the pedometer data is rather one-dimensional and as such might not sustain interest for too long. Adding information about the users' average speed or length of average walks taken might be interesting for the social group. A social function that the participants hoped to see in future devices was the possibility to see where friends are located in order to join them for exercise.

We did not continue to formally follow the participants after the two-month trial, but we have knowledge that at least two of the participants still use the device daily, eighteen months after the trial. This is in itself interesting, as in most studies such long-term use is not achieved. We assume this might be related both to the sequential introduction of functions and the role of the focus group administrator, but this needs to be investigated further.

Limitations of the study at hand include the impossibility of replicating individual case studies and the fact that the results and findings might be different if the study participants would have had a different demographic profile, e.g. have less prior knowledge of technology. On the other hand, our study design enabled us to gain a very rich picture of the participants, which will be helpful in informing and designing future studies. To address the limitations of the current study we are continuing our research with a larger, more heterogenic sample and with different research designs (e.g. a survey study).

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Reviewing Organizational Design Components for Digital Business Strategy

TIMO WEINRICH

Abstract The view on information technology strategy has changed significantly. In the past, a functional-level view was prevailing, where information technology (IT) strategy was subordinate to a deliberate business strategy and needed alignment. Recently, rapid developments in digital technologies leaves no industry untouched and IT becomes an enabler and differentiator for businesses. Therefore, IT strategy exceeds the view of alignment towards a fusion of business- and IT-strategy– coined as digital business strategy (DBS). Yet, strategies are inextricably linked to organizational design in order to function well. Consequently, a DBS requires a suitable underlying organizational design. This paper aims to explore the very organizational design components for DBS by examining the state of the art literature. Specifically, this paper sheds light on the organizational design components of strategy, structure, processes, rewards, and people. The research method is a review of relevant literature at the intersect of information systems (IS) and management. Conclusions, implications for research and practice are presented.

Keywords: • Digital Business Strategy • Organizational Design • Literature Review •

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1 Introduction

In the past, the predominant view on IT strategy was a functional-level view. IT strategy was treated subordinate to a deliberate business strategy and needed to be aligned with it (Henderson & Venkatraman, 1993; Venkatraman, 1994). However, steady improvements in price/performance ratio of technology as well as advances in information, computing, communication, and connectivity technologies bring new functionalities, which affect society and economy at large. In today's uncertain environment, IT supplies crucial dynamic capabilities and becomes an imperative part of strategy formulation (O. A. El Sawy, A. Malhotra, Y. Park, & P. A. Pavlou, 2010; Yoo, Henfridsson, & Lyytinen, 2010). For example, digital technologies (combinations of information, computing, communication, and connectivity technologies) have the power to change business strategy towards a cross functional, modular, distributed nature with global business processes that "enable work to be carried out across boundaries of time, distance and function" (Bharadwaj, El Sawy, Pavlou, & Venkatraman, 2013, p. 472). To capture this development, Mithas and Lucas (2010) and Omar A El Sawy, Arvind Malhotra, YoungKi Park, and Paul A Pavlou (2010) introduced the concept of DBS: Instead of viewing IT strategy subordinate to business strategy, the authors conceptualize a fusion of business strategy and IT strategy. The concept promotes the view, that IT strategy is much more than just a functional strategy because, nowadays, digital resources are an integral part of almost every organizational area. Digital technologies can create a differential value and increase innovative strength to generate a competitive advantage. Consequently, they are more than just systems and technologies (Bharadwaj et al., 2013). Bharadwaj et al. (2013) further elaborate on the DBS concept and provide a general understanding of DBS. The authors identify key themes and possible research directions, which the authors center around scope, scale, speed and sources of value creation and capture of DBS. (i) scope: DBS transcends functional areas, digitization of products and services, disruption of traditional supply chains towards ecosystems; (ii) scale: scaling of IT as an adaptive capability, network effects enabled by multisided platforms, information abundance, scaling via partners; (iii) speed of: product launches, decision making, supply chain orchestration, network formation and adaptation; (iv) sources of value creation and capture: increased value from information, value creation from multisided business models, value creation through coordinated business models in networks and value appropriation through the control of digital industry architecture. Whereby, Bharadwaj et al. (2013) remark that the identified trends and organizational shifts are merely illustrative and not exhaustive.

Yet, any strategy needs a matching organizational design in order to be carried out. The organizational design may unleash organizational capabilities (combination of skills, processes, technologies, and human abilities that differentiate a company), which in turn can translate to a competitive advantage – the overall purpose of strategy (Kates & Galbraith, 2010). Any change in strategy requires a change of organizational design (Dosi, Nelson, & Winter, 2001). Thus, organizations that pursue a DBS also need a matching organizational design that is different from "traditional designs" (Bharadwaj et

al., 2013). Similarly, Matt, Hess, and Benlian (2015, p. 341) state “with different technologies in use and different forms of value creation, structural changes are often needed to provide an adequate basis for the new operations. Structural changes refer to variations in a firm’s organizational setup [...]”. Such organizational changes are independent of the industry or organizations and usually have certain aspects in common (Matt et al., 2015). In sum, a novel organizational design under DBS is acknowledged, but research that explicitly addresses and reviews this subject is scarce. Therefore, the following research question is formulated to address this research gap: “What is the state of knowledge on organizational design in the context of digital business strategy?” In order to answer the research question, we adopt the organizational design perspective of Galbraith (1977), a well-established organizational design framework, which consists of five interrelating categories: strategy, structure, processes, rewards, and people (see 2.2 Framework). Accordingly, the unit of analysis is on the organizational level perspective.

2 Methodology

2.1 Literature Review

Paré, Trudel, Jaana, and Kitsiou (2015) provide a detailed view on different review types. The authors develop a typology shown in “Table 1: literature review types”, including a brief description of each type:

Table 1: Literature review types by Paré et al. (2015)

Review Type	Description
Narrative	Unstructured approach to identify existing knowledge on a certain topic or subject
Descriptive	Structured approach to identify existing knowledge on a certain topic or subject
Scoping/ mapping	Uncovering the amount and nature of literature on a certain topic
Meta-analyses	Quantitative evaluation of similar studies by combining their data
Qualitative systematic reviews	Qualitative evaluation of similar studies by combining their data
Umbrella/overview	Integrates multiple systematic reviews (quantitative or qualitative)
Theoretical	Draws on multiple existing studies (empirical and conceptual) and transcends them to a model or higher conceptual framework
Realist/ meta-narrative	Theory driven to inform, enhance, extend or supplement existing reviews
Critical	Analyzes existing knowledge and reveals inconsistencies, contradictions, controversies or weaknesses

This piece of research is most in line with a descriptive review type because it shares numerous aspects with this type: (i) it summarizes the prior knowledge, (ii) the scope of the research question is relatively broad, (iii) the search process (following paragraph) is comprehensive, (iv) the identified literature is of conceptual and empirical nature, (v) the identified literature is selected via certain predefined selection criteria (following paragraph), (vi) due to the relatively young phenomenon of DBS, an appraisal for only high quality is not the focus (vii) synthesizing and analyzing the identified literature centers thematically around a given framework (following section) (Paré et al., 2015).

A detailed and systematic search process is important to yield a rigorous, unbiased, objective, transparent and replicable review. Therefore, a review should provide explicit information on how the literature is identified, selected, assessed and synthesized. First, it should outline the research question(s), sources searched, search terms, search strategy and inclusion / exclusion criteria. Afterwards, the actual search is performed. The relevant literature is selected according to the chosen selection criteria and subsequently analyzed. Evidence is summarized and presented (Boell & Cecez-Kecmanovic, 2014; Wolfswinkel, Furtmueller, & Wilderom, 2013).

The research questions, already presented in the introduction, is "What is the state of knowledge on organizational design in the context of digital business strategy". The initial keyword search for the topic relevant literature is conducted by drawing on 50 major IS journals and 16 IS conferences as proposed by Levy and Ellis (2006, p. 186). It is complemented by the Financial Times 50 list (FinancialTimes, 2017). In doing so, the scope of our search covers the dual aspects of DBS and organizational design for this study, i.e., management literature on the one hand and IS literature on the other hand. In the following, the three major steps to conduct this literature review are presented: (i) keyword search, (ii) backward search and (iii) forward search (Webster & Watson, 2002):

- (i) The keywords applied for searching within the journals and conference proceedings are "digit* business strateg*" OR "digit* strateg*", whereby asterisks are placed to cover any variation of the words. The keyword search is applied to peer-reviewed only and title, abstract and keywords fields (if not available, full text). The selection for relevant articles takes place by reading the title, keyword, and abstract first (or further if still unclear). The criteria for judging the relevancy of the obtained articles is an explicit (i) linkage to DBS and (ii) linkage to the organizational design framework (following section 2.2 Framework).
- (ii) The next step is to perform a backward search, i.e., reviewing the citations of all relevant articles identified during the keyword search. Applying the same selection criteria for the backward search one obtains relevant prior articles that should be considered for this study.
- (iii) Finally, the last step is the forward search, which is the process of identifying relevant articles that build on the previously identified articles, also known as cited by. For this process, Web of Science and Google Scholar are used because

both search engines proved to show occasionally diverging search results and therefore complement each other. Again, for this step the introduced relevancy criteria are applied, which resulted in the final sample of 39 articles (see section 6 Appendix “Table 2: concept matrix of analyzed articles and organizational design components”).

2.2 Framework

Organization design can be viewed as a chain of decisions and choices and collectively refers to the “process of configuring structures, processes, reward systems, and people practices to create an effective organization capable of achieving the [digital] business strategy” (Kates & Galbraith, 2010, p. 1). Initially, it originates from Galbraith (1977) well-established organizational design framework that consists of the intertwined components of strategy, structures, processes, rewards and people. The following paragraph introduces each component briefly.

The component strategy determines a company’s course of action and can be understood as the cornerstone of the organizational design. It originates from the decision-makers’ understanding of the various environmental influences such as new technologies, competitors, customers, suppliers etc. Essentially, it is the success formula to gain a competitive advantage and differentiation.

Structure refers to the organizational chart and key roles. Some common types of organizational structures are functional, product, geographic, or customer-centric structures. It represents the possibilities of how to group different people together in an organization. Furthermore, it clarifies responsibilities, decision-making powers, and authorities.

The component processes refers to any connected activity that is linked with the information flow within and across an organization. Processes dissolve collaboration barriers that may result from an organization’s structure. Well-designed processes ensure that e.g., the right people find each other to innovate a new product. Processes can determine mechanisms for collaboration and therefore how well units within and across organizations work together.

Rewards have the purpose to harmonize the behavior and performance of individuals with the overall goals of an organization. It includes e.g., rewards based on measures or variable compensation.

The component people contains practices like selecting, training, staffing and developing of people to gain desired capabilities and a mind-set to successfully execute the strategy. This may include e.g., competencies like interpersonal skills and decision making capabilities such as considering multiple points of view (Kates & Galbraith, 2010).

3 Findings

The following subsections present the findings of the identified literature on DBS and organizational design along the framework's components of strategy, structure, processes, rewards, and people. Whereby, the appendix includes a summarizing table "Table 2 Concept matrix of analyzed articles and organizational design components" and figure "Figure 1: Cumulative articles published on DBS and organizational design components".

3.1 Strategy

Following a DBS implicates establishing new capabilities, e.g., process-, customer and performance management (Mithas, Agarwal, & Courtney, 2012). Specifically, organizations desire an increased agility and responsiveness, multi-channel ecosystem connectivity, visualization and governance of data and information. In order to obtain this, organizations need to invest in multiple IT-enabled efforts (Freitas Junior, Maçada, Brinkhues, & Montesdioca, 2016). In fact, Mithas, Tafti, and Mitchell (2013) show that under higher industry dynamics, organizational spending differs for DBS related activities and vice versa for industry growth and concentration. Technology related investments may allow organizations to solve ambidextrous strategies, like a DBS, because it often involves pursuing multiple goals at once e.g., by following revenue growth and cost reduction at the same time (Bonchek & France, 2015; Mithas et al., 2012). However, Woodard, Ramasubbu, Tschang, and Sambamurthy (2013) show that organizations are path-dependent when it comes to designs of their existing digital artifacts. The authors refer to "design moves", resulting options/debt of past investments that enable/constrain strategic actions of organizations. Strategic paths can also be disrupted via a destabilization of self-reinforcing mechanisms resulting from digitalization (Wenzel, Wagner, Wagner, & Koch, 2015). Though, DBS is not only about optimizing internal operations or responding to single competitors, it is also about the responsiveness and awareness of the whole competitive environment (Mithas et al., 2013). This may open up new choices for digital business models, like Netflix, who first started with efficient delivery system of physical DVDs and later, due to digitization of media, the organization seized the opportunity and became the market leader for online media streaming (Mithas & Lucas, 2010). Therefore, IT does not just support strategic goals but increasingly becomes an enabler of strategic goals (Hess, Matt, Benlian, & Wiesböck, 2016). As strategy originates from the decision makers understanding of environmental influences (Kates & Galbraith, 2010), for DBS, this is the case for pervasive digital technologies (Bharadwaj et al., 2013). Digital technologies are an integral part of DBS formulation (Yoo et al., 2010). In line, the identified literature shows, that many DBS of organizations encompasses engaging in harnessing digital technologies to gain a competitive advantage and differentiation.

This includes engaging in social media for various purposes. Organizations increasingly use social media such as wikis or blogs for internal and external communication and collaboration (Delerue & Vuori, 2012; Ross et al., 2016). Regarding social networks,

organizations leverage and create value from it by fostering additional transactions out of social media relationships. Catlin, Patiath, and Segev (2014) emphasize to digitally connect with (existing) customers by extending digital marketing activities, to retain customers and improve cross- and up-selling. A more nuanced view is provided by Oestreicher-Singer and Zalmanson (2013), who demonstrate that social media should not just be a substitute to offline marketing activities. In order to generate value from social media, organizations need to “[...] take a strategic rather than techno-centric view of social media, that integrate social media into the consumption and purchase experience” (Oestreicher-Singer & Zalmanson, 2013, p. 591). However, social media does not always complement organization’s DSB. Increasingly, social media companies compete with e.g., news media or mobile services providers (Palekar & Sedera, 2015).

Yet, social media is much more of just another customer touchpoint. Next to wearables, tracking customers via cookies or app permissions etc., social media is a valuable source of information. For example, combined with data analytics it yields customer insights and a better customer understanding (Catlin et al., 2014). Analytics can provide meaningful insights and enable organizations to scale recommendations and offer products and services on a highly personalized level (Bonchek & France, 2015; Ross et al., 2016). Thus, the analysis of large data is often an integral part of DBS to e.g., become a more customer centric organization because “[...] the buyer, not the seller, determines which dimensions of value matter and how offers compare” (Keen & Williams, 2013, p. 644). Other application fields of analytics within DBS also include the support for strategic and tactical decision-making and business processes (Watson, Wixom, Hoffer, Anderson-Lehman, & Reynolds, 2006). In sum, analytics of large datasets are a key under DBS (Bhimani, 2015) and has the power to create a sustainable competitive advantage (Erevelles, Fukawa, & Swayne, 2016).

Next to social media and analytics, cloud computing is also frequently mentioned within the identified articles. Yet, Goutas, Sutanto, and Aldarbesti (2015) highlight, that many organizations simply adopt it without having a clear DBS. In order to unleash the full potential of cloud computing, it not only has to fit to the existing processes and systems, but also has to be part of an overall DBS. DBS on cloud computing usually encompass the intention for optimization, innovation and/or disruption (Berman, Kesterson-Townes, Marshall, & Srivathsa, 2012b). Nevertheless, the overall focus should be the value creation to customers by e.g., increasing software security and customization. Only then, cloud computing enables DBS to transition to new, digital business models (Berman, Kesterson-Townes, Marshall, & Srivathsa, 2012a). Likewise, in a qualitative study Cowen, Johnston, and Vuke (2016) show, how cloud computing increasingly becomes an integral part of organizations DBS in a developing country. Their main findings indicate that via cloud solutions, organizations achieve a better return on capital, improved quality and efficiency, better customer relationship and innovation acceleration and it has a cultural impact.

Finally, Ross, Beath, and Sebastian (2015) highlight that, in order to realize a competitive advantage from digital technologies in general, organizations need to gain a holistic

picture and not just focus on individual solutions. This means, to invest with caution, to achieve integrated and not just isolated solutions. For example, not only to just invest in mobile technology by offering apps and customer service (Catlin et al., 2014). Overall, “[...] a strategic focus that directs their technology spending [on] social, mobile, analytics, cloud, and internet of things technologies” (Ross et al., 2015, p. 2), is needed to foster new capabilities that make sense for DBS.

3.2 Structure

To implement a DBS successfully, organizations have to align their structure correspondingly. Literature shows, that there are several common practices for DBS. In general, Catlin et al. (2014) emphasize, that the governance and operating model need to fit to the organizations “digital maturity”. Together with an increasing digital maturity a lot of the organizational functions become decentralized and embedded in business unit activities. Increasingly, organizations create units that consist of cross-functional teams e.g., of technology and operation for business lines, to achieve a better responsiveness (Sia, Soh, & Weill, 2016). Others contributions highlight the launch of innovation labs detached from an organization (Ross et al., 2015). In sum, organizations need to decide how to integrate digital operations into their existing structures or separate it from the core business (Hess et al., 2016).

Additionally, DBS needs to be communicated organization-wide by the senior management and managers at all levels across an organization should be enlisted in technology decisions. In so doing, Mithas and Lucas (2010) and Sia et al. (2016) point out, that the CEO, CIO and the senior management need to work tightly together to execute a DBS. For example, the “CIOs must engage their business counterparts to shape IT decisions and create buy-in for IT efforts” (Mithas & Lucas, 2010, p. 4). Likewise, not all power over the DBS should be located at a single department, for example, at the marketing department, which might only lead to customers’ attention shortly but will not provide sustainable value (Haque, 2015). Some organizations introduce a Chief Digital or Data Officer (CDO), a dedicated position within an organization who is in charge of the DBS. In this case, too, interactions and collaboration between the CDO and the other management is critical for DBS success. The CDO role, tasks, responsibilities and reporting structure need to be articulated clearly – particularly with respect to the CIO as a neighbored manager (Haffke, Kalgovas, & Benlian, 2016; Hansen & Sia, 2015; Horlacher, 2016). Especially, since it is known that a tight CIO-CEO reporting structure is beneficial for differentiation (Banker, Hu, Pavlou, & Luftman, 2011). Thus, the reporting structure needs to fit to the DBS of an organization. In sum, DBS affects the whole organizational structure along with the power over the DBS execution, which may vary from organization to organization (Hess et al., 2016). In line, Matt et al. (2015) come to the conclusion, that there is no distinct answer, who should be in charge of the DBS.

3.3 Processes

As introduced, the component processes refers to any connected activity that is linked with the information flow within and across the organization. The following paragraphs highlight the (i) information flow within an organization, (ii) the information flow from the outside in and, (iii) from the inside out of an organization.

First, the credo for DBS is “what can be digitized will be digitized” to cut costs and increase service quality. Therefore, digitization, optimization and standardization of processes are imperative to allow for e.g., straight-through processing or and rapid product configuration (Catlin et al., 2014; Hess et al., 2016; Ross et al., 2016). As already mentioned for the component structures, teams from different departments or innovation labs are a common practice. The intention is to achieve a culture of experimentation, agility for innovation processes and an increase in the speed of product launches. This includes “test-and-learn” processes and allow failures as an example for new product development and as a part of the innovation process (Bonchek & France, 2015; Ross et al., 2016; Sia et al., 2016). It is increasingly encouraged that every employee can participate and give feedback (Sia et al., 2016). Additionally, social media is often used to internally or externally crowdsource ideas (Delerue & Vuori, 2012). Under DBS sophisticated customer service processes are gaining more and more importance to achieve customer orientation and customer response in order to answer changing customer demands. Setia, Venkatesh, and Joglekar (2013, p. 585) exemplarily state that for “[...] the sophistication of customer service processes and goals of customer service performance, firms may customize their initiatives to build effective digital designs across customer service units”.

Second, nowadays organizations usually operate within whole business ecosystems and make use of shared products and platforms and processes become increasingly commoditized. Markus and Loebbecke (2013) introduced the term “commoditized processes”, which are processes that are conducted in the same way, for example by using SAP or Salesforce. In contrast, standardized processes can still be customized individually e.g., an industry norm. Organizations that use commoditized processes do not necessarily have to interact in some way, but it can accelerate activities like (future) partnering or outsourcing (Markus & Loebbecke, 2013). Yoo et al. (2010) point out, that it can be a challenge for organizations to coordinate and manage distributed and dynamic processes of maintaining and designing IT infrastructures at a corporate level. Nevertheless, it is not a question of if but how to interface to customers, partners and suppliers because they are a critical source of innovation under DBS (Keen & Williams, 2013). More and more, organizations need to be able to integrate and process heterogenic internal and external information and knowledge resources. Being able to combine and store data from various databases can be used for different fields of application (Ross et al., 2016), such as a seamlessly omni-channel experience for customers (Hansen & Sia, 2015) or speed up the decision making process by using e.g. real-time business intelligence (Watson et al., 2006). In addition, it becomes increasingly important to not

only know the customer but also to process and lever relevant information e.g., via analytics as shown in the subsection strategy (Bonchek & France, 2015). This also requires integrating different sources of information such as new channels like apps, social media and webpages, not only with traditional offline channels but also with the inventory management system (Oestreicher-Singer & Zalmanson, 2013; Ross et al., 2015; Ross et al., 2016).

Third, in today's world of ubiquitous information, stakeholder of an organization like their customers are empowered, well informed and want organizations to be transparent about their product quality, features, etc. in order to trust them (New, 2010). Therefore, organizations need to take care of the process, which and how information flows from the inside out. Granados and Gupta (2013) argue that transparency is a relevant part of DBS and organizations should selectively and strategically disclose information to their stakeholders. Nevertheless, Grover and Kohli (2013) debate, that organizations need to be cautious about exposing systems' software, process, and information, which might expose strategic intentions to competitors and thus potentially give away a competitive advantage. In line, Dewan, Freimer, and Jiang (2007) highlight that transparent information, such as stock and price information, could also be used by competitors and not only by customers. In sum, under DBS the information flow out of an organization can be described as a balancing act of giving away just the right information to stakeholders (Grover & Kohli, 2013).

3.4 Rewards

The organizational design component rewards shows the fewest results in the literature. Only Catlin et al. (2014) emphasize that organizations need to reward a more risk-taking behavior, which should yield in a test-and-learn culture. However, the authors are not explicit on how this behavior is rewarded only that "digital spend [should be] measurable in terms of return on investment." (Catlin et al., 2014, p. 3). Similarly, when it comes to the specific person(s) that are in charge of the DBS endeavor, their incentives should be directly linked to the target and progress of the DBS (Matt et al., 2015).

3.5 People

The role of digital talents is crucial for organizations that engage in DBS because new skillsets are required as digital technologies impact organizations at large (Hess et al., 2016). For example, it requires managers not only to think in terms of business or IT but with a deep understanding of DBS (Bonchek & France, 2015). Specifically, competencies and knowledge is required on how to synchronize IT and business strategy, IT governance, implement IT projects, and manage the organizational IT infrastructure in order to be successful in DBS (Haffke et al., 2016; Hansen & Sia, 2015; Mithas et al., 2012; Mithas & Lucas, 2010; Valentine & Stewart, 2015). Leaders need to be open towards innovation and know how digital technologies and ubiquitous information affect their organization. This also includes an organization's ecosystem, which consist of their

stakeholders like customers, alliances, employees, suppliers etc. Such an understanding is the foundation to lever digital resources and create value for an organization (Bennis, 2013; Favaro, 2016; Sia et al., 2016). In so doing, it may help an organization to preserve a competitive advantage or to gain new competencies and define a new competitive advantage (Mithas et al., 2012; Mithas & Lucas, 2010). Nevertheless, managers need to be capable to communicate the DBS and their beliefs organization wide to create a common understanding (Mithas & Lucas, 2010). This is especially important because DBS affects the whole organization and any change may bring resistance to some degree (Matt et al., 2015). Digital talents can either be recruited externally or internally, by hiring people with the sufficient experience from academic institution or other (digital) organizations, mergers and acquisitions or training via dedicated digital training programs (Catlin et al., 2014; Hess et al., 2016; Matt et al., 2015).

4 Summary and Conclusion

Overall, this literature review contributes to the body of DBS and organizational design. It sheds light on DBS and organizational design by specifically looking at the components of strategy, structure, processes, rewards and people (Bharadwaj et al., 2013; Galbraith, 1977). Considering strategy, it is evident, that digital technologies have to be an integral part of DBS. Yet, the majority of identified articles specializes on certain digital technologies under DBS and do not treat them in a holistic manner as frequently emphasized (Ross et al., 2015). Additionally, there is a strong focus on harnessing cloud computing, analytics and social media under DBS. Whereas, mobile technologies are underrepresented but not less important (Cisco, 2017). In terms of structures, this piece of research points out that under DBS organizational functions become increasingly decentralized. It is also evident that the reporting structures and decision-making power shifts since DBS is an organization-wide endeavor and needs orchestration within and across the organization. However, how organizations achieve this is quite heterogeneous (Matt et al., 2015). Regarding the component processes, an increasing interfacing with the ecosystem, which includes customers, partners, suppliers and possibly competitors, is key. Organizations need to be capable to lever their ecosystem because it is a critical source of value creation by e.g., fostering innovation (Keen & Williams, 2013). Regarding the component rewards, this literature review found surprisingly little on harmonizing individual behavior with the overall goal of an organization. While literature mentions the importance of this aspect, only little information is given. Finally, the component people shows that to follow a DBS, digitally skilled employees and leaders are needed, which understand digital technologies, their strategic implications and know how to create business value from it. Overall, this literature review is able to show that in order to carry out a DBS, organization design requires a large shift. Yet, the presented organizational design components for DBS should not be treated mutually exclusive but as interrelating components, which need to be closely aligned to complement each other to be successful.

Limitations of this literature review exist because, for example, an organizational design perspective is adopted, which inhibits an in depth examination of DBS from an ecosystem perspective – another important aspect of DBS e.g., Pagani (2013). Additionally, only literature is included that explicitly refers to digital strategy / digital business strategy and components of the framework.

This contribution has practical and research implications likewise. The practical implications highlight the need for a suitable organizational design under DBS. In doing so, this review also shows practical audience, common organizational shifts for the components strategy, structures, processes, rewards and people. These design components are directly under the control of leaders and, therefore, organizations pursuing a DBS can draw from these insights and transfer them to their organizational context. Moreover, companies should reconsider existing portfolios of single DBS speedboat initiatives and treat them in a more holistic manner by orchestrating them. By doing so, the initiatives complement each other meaningfully and unleash their full potential.

Common research implications for literature reviews are uncovering research gaps and pinpointing possible future research questions. Thus, a review typically can give guidance for future research (Webster & Watson, 2002). For strategy, future research directions encompass how and which single and formerly isolated digital technology solutions complement each other. Due to this, future research is emphasized to yield an integrative and holistic picture of digital technologies under DBS. In addition, mobile devices are getting smarter and mobile data traffic is increasing exponentially (Cisco, 2017). Yet, their implications for DBS are still not fully examined and require future research. For the component structure, one can observe heterogeneous approaches of organizations. Therefore, an analysis of which structure may lead to superior organizational performance is emphasized. This may include reporting structures and distribution of power in general, new roles like the CDO, team settings like cross-functional teams etc. For the component processes, integrating and analyzing different sources of large amounts of information becomes increasingly important differentiator and a source of value. Yet research at the intersection of DBS and digital business infrastructure, i.e., how do incumbent firms build a digital business infrastructure, is still scarce. Another research gap is evident for the component rewards. Future research may look at how to harmonize individual behavior with DBS, including metrics and measures. Finally, organizational design can influence not only organizational performance but also organizational culture (Kates & Galbraith, 2010). Organizational culture is an output of the “[...] cumulative design decisions that have been made in the past and of the leadership and management behaviors that result from those decisions.” (Kates & Galbraith, 2010, p. 3). This means leadership cannot directly influence organizational culture but indirectly via the organizational design. The impact of DBS on organizational performance has been proposed and examined in some recent contributions, e.g. (Freitas Junior et al., 2016; Leischnig, Wöfl, & Ivens, 2016). However, little is known on how culture changes or looks like under an organizational design for DBS. Therefore, future

research should elaborate on this topic. Additionally, drawing on a different framework for DBS could yield additional insights. Finally but yet importantly, a change in organizational design under DBS intends to unleash new capabilities, that in turn may lead to a new business models (DaSilva & Trkman, 2014). Thus, questioning, what are new or typical business models resulting from pursuing DBS with a corresponding organizational design.

Appendix

Table 2: Concept matrix of analyzed articles and organizational design components. S=social media, M=mobile technologies, A=analytics C=cloud computing, G=general, IN=information flow within an organization, OI=information flow outside in of an organization IO=information flow inside out of an organization.

#	Reference	Strategy					Structure	Process			Reward	People
		S	M	A	C	G		IN	OI	IO		
1	Banker et al. (2011)						.					
2	Bennis (2013)											.
3	Berman et al. (2012)				.							
4	Bharadwaj et al. (2013)					.						
5	Bhimani (2015)			.								
6	Bonchek and France (2015)			.		.		.	.			.
7	Catlin et al. (2014)	.	.	.			.	.			.	.
8	Cowen et al. (2016)				.							
9	Delerue and Vuori (2012)	.						.				
10	Dewan et al. (2007)									.		
11	Erevelles et al. (2016)			.								
12	Favaro (2016)											.
13	Freitas Junior et al. (2016)					.						
14	Oestreicher-Singer and Zalmanson (2013)	.							.			
15	Goutas et al. (2015)				.							
16	Granados and Gupta (2013)									.		
17	Grover and Kohli (2013)									.		
18	Haffke et al. (2016)						.					.
19	Hansen and Sia (2015)						.		.			.

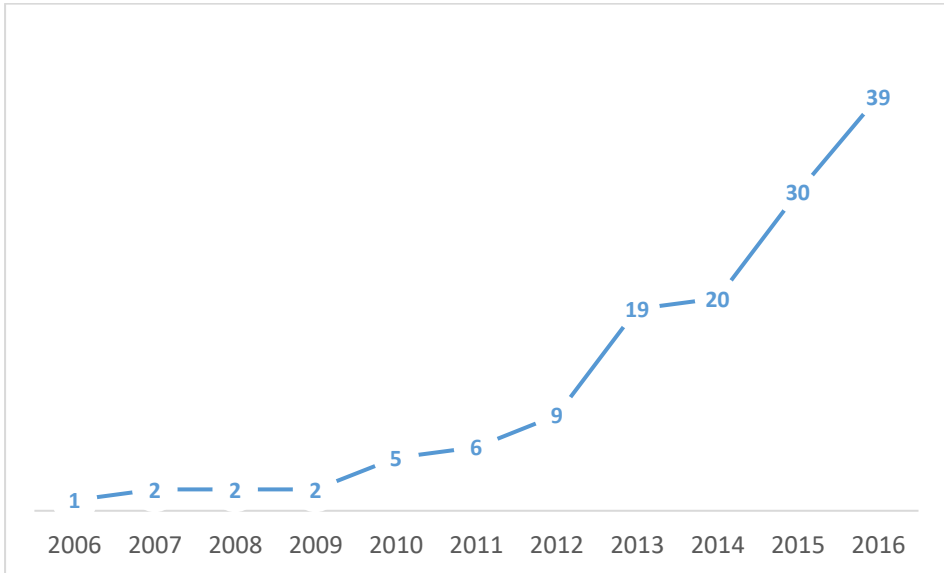


Figure 1: Cumulative articles published on DBS and organizational design components. The numbers on the line represent the cumulative articles published up to the corresponding year.

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Behaviour Intentions to Use RFID Subcutaneous Microchips: A Cross-sectional Slovenian Perspective

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Abstract This paper presents the second iteration results of a study investigating the possibility of radio frequency identification device subcutaneous microchip (RFID-SM) usage as a substitute for personal identification, healthcare issues, shopping or payments, and home usage. Our aim was to investigate the readiness to use SM-RFID in everyday life. In the study, we used an extended Technology Acceptance Model (TAM) to verify the main concerns regarding the use of RFID-SM among Slovenian people. The survey responses were gathered from October until December 2016. After evaluating the model, it can be concluded that the fit of the model is good and the significant path of dependence are similar as in the first study from 2014. Similar to previous results, the Health Concerns have a negative effect on the Perceived Trust and Perceived Usefulness of SM-RFID adoption. On the other hand, the Perceived Trust and Perceived Usefulness have a positive effect on the Behaviour Intention to use SM-RFID.

Keywords: • RFID • subcutaneous microchip • implant • adoption • everyday life •

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1 Introduction

In the era of the Internet of things (IoT) the information and communication technology (ICT) is used to support everyday tasks of people (e.g. Baquero, Cabrera & De Sousa, 2016). The number of different smart or magnetic stripe cards, keys and various other devices for personal identification, financial transactions, unlocking of doors, etc. has become unmanageable. When near field communication (NFC) became available on mobile phones, some cards were offered as a mobile service. To increase security, most of the magnetic cards were equipped or replaced with radio frequency identification device (RFID) microchip and NFC possibility. RFID microchips can be used for shopping, health care services, logistics, car industry and domestic usage.

During the research on diverse types of personal identification, questions about a unified type of identification arose. People are no longer willing to operate with the diversity of identification cards and passwords needed to efficiently manage their professional and personal life. Recent studies have shown that the RFID technology is secure enough to be used for personal identification and some attempts were made to use RFID subcutaneous microchip implants (RFID-SM) (Bergmann et al., 2012; Gasson & Koops, 2013; Madrid, Korsvold, Rochat & Abarca, 2012; Soares dos Santos et al., 2013).

Body-implantable devices for non-medical purposes are emerging as a hot topic that has the potential to permeate throughout society (Catherwood, Finlay & McLaughlin, 2016). According to Graafstra (interviewed by Michael, 2016), the attitude of consumers has changed from being unaware about the possible usage of RFID implants to general acceptance of RFID implants as a kind of jewellery. In recent years, people are becoming aware that the RFID-SM present a plausible future (Michael, Michael & Perakslis, 2015). Heffernan, Vetere & Chang (2017) even introduce a new concept called “insertables”. Nevertheless, some researchers still explore the potential negative impact of enforced microchipping (Bradley-Munn, Michael & Michael, 2016), while others look for highly positive effects of RFID implants. Namely, implantation of RFID microchips in tumours may provide a new method for cancer treatment (Lai, Chan & Singh, 2016).

The literature review showed several attempts to research the readiness of RFID-SM adoption from the provider’s viewpoint (e.g. hospital management, doctors) (Cao, Jones & Sheng, 2014; Hossain & Quaddus, 2015), while only a few of them dealt with the end-users (e.g. patients) (Katz & Rice, 2009). In addition, most of the studies are focused only on RFID-SM usage for the healthcare purposes.

This research is a continuation of the research conducted in 2014 (Werber & Žnidaršič, 2015), when readiness of potential RFID-SM users to adopt the microchips in their everyday life was researched. There are two reasons of survey repetition and upgrade:

- The attitudes towards technology acceptance change rapidly, so we wanted to compare the new results with the results from 2014,

- The study was extended from Slovenia to some other countries (e.g. Poland, Croatia).
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In this paper, the responses gathered in Slovenia are presented, to enable a consistent comparison with the results gathered in 2014 (Werber & Žnidaršič, 2015).

Similar to Chong, Liu, Luo & Keng-Boon (2015), the basic Technology Acceptance Model (TAM) was extended with three additional external variables which enabled us to include all of our research questions. Health Concerns (HC) were included in the model according to the results of previous studies on RFID adoption (Foster & Jaeger, 2007; Katz & Rice, 2009; Rotter, Daskala & Compano, 2008), Perceived Trust (PT) has similar to HC gained a lot of attention in the research community (Garbarino & Johnson, 1999; Smith, 2008; Suh & Han, 2002; Tung, Chang & Chou, 2008; Wu & Chen, 2005). Furthermore, age was included as a predictor variable of Behaviour Intention to Use (BIU) since younger people are more prone to adopt new technologies (Burton-Jones & Hubona, 2006; Morris & Venkatesh, 2000).

2 RFID microchip

With the development of technology and robotic production, the capacity of microchip has multiplied while the size of it was minimised. The biggest challenge today is not the size of a microchip (0,05mm x 0,05mm). The problem is the size of the antenna that should be at least 1mm long to get reliable results (Burke & Rutherglen, 2010). Depending on power needed for operating, RFID microchips are categorised into three types: passive, active and semi-passive. While passive devices don't need any internal power, the active do and their life time depends on battery capacity, usually not longer than one year (Ruiz-Garcia, Lunadei, Barreiro & Robla, 2009). Semi-passive devices present a combination of both other types.

While data stored in a passive NFC RFID-SM microchip can be read with the help of electromagnetic field produced by a reader device, the sensor (temperature sensor, PH sensor, etc.) needs a power supply (Badia-Melis et al., 2014). To overcome this problem, the researchers are trying to develop rechargeable implanted batteries that produce electricity with the chemical reaction of body fluids – glucose bio-batteries (Yazdi et al., 2017).

We can find the application of RFID microchip in manufacturing, supply chain management (Yee-Loong Chong et al., 2015), logistic, automotive industry, livestock production (Iyasere, Edwards, Bateson, Mitchell & Guy, 2017), food production and public sector (Dwivedi, Kapoor, Williams & Williams, 2013). RFID microchip is used in shops, passports, proximity cards, automated toll-payment transponders, ignition keys, contactless credit-cards, smart bracelets, smart finger rings, smart watches, etc. (Juels, 2006).

In healthcare we can use RFID for resource management (Fisher & Monahan, 2008). There are also RFID systems for tracking patients and personnel (Baker, 2016; Fosso Wamba, Anand & Carter, 2013). Besides, the high number of health care errors (up to 98,000 per year) causing death can be reduced when using RFID system for monitoring patients (Baker, 2016).

There were several attempts of using RFID-SM in vivo. The first human with active RFID-SM implant was Professor Kevin Warwick in 1998. He was able to programme doors to open and lights to switch on when he approaches the RFID reader. He removed the chip after nine days in order to avoid possible health complications due to the battery lifetime. In 2002 the Jacobs family members were implanted by Very chip (Ip, Michael & Michael, 2008). One of first recorded commercial use of RFID-SM was in 2004 in the Baja Beach Club in Barcelona, Spain, and Rotterdam (Ip et al., 2008; Michael & Michael, 2010). An RFID-SM with a unique code for identification of very important persons (VIP) was used to enable electronic payment and access to VIP areas of the club. The name of the person was displayed publicly on screens upon their entrance to the club. In 2005, three employees of the U.S. Company Citywatcher.com were implanted with microchips for access control application. In the same year, the Very Chip was used for medical reasons to identify patients for the first time in the USA. Volunteers were chipped in hand or arm with local anaesthetics. The system was able to recognize 16 digit identification code to identify and gain an insight into patient medical record data (Michael & Michael, 2013). The author of the book RFID toys (Graafstra, 2006), Amal Graafstra's initial motivation to get a chip implant was for the convenience of eliminating keys (Ip et al., 2008). In 2013 first commercial company called Dangerous Things was established and started to sale the first RFID-SM for home use (Michael, 2016).

The presented study considered the usage of the passive NFC RFID-SM of size 2mm x 12mm, similar to the glass-coated used for animals' identification. There are more than 5 million house pets with such chips, which enable identification of the pet's owner (Juels, 2006).

3 Research approach

3.1 Data collection

The study about attitudes toward RFID-SM among Slovenians was performed from April to December 2016. The link to the web questionnaire was sent via email to members of researchers' social networks and it was posted on the faculty web page.

3.2 Questionnaire and research hypotheses

The research model includes all three basic concepts of TAM (Morris & Venkatesh, 2000; Ronteltap, Fischer & Tobi, 2011): Perceived Ease of Use (PEU), Perceived Usefulness (PU), and Behaviour Intention to Use (BIU). The basic concepts are combined with two

external factors (Werber, Baggia & Žnidaršič, 2016): Perceived Trust (PT) and Health Concerns (HC). Furthermore, two manifest variables are included: age and painful procedure; first with hypothesized direct impact on BIU, and the second on HC.

PU has seven items which are in accordance with items proposed by proposed by Davis (1989) in the original TAM model. Five of them were adopted from (Katz & Rice, 2009), and two additional items on storing information about organ donation and a general statement on saving lives in different medical conditions were added. PEU and PT items were adopted based on Davis (1989) and Smith (2008), respectively. PT refers to an individual's trust that the state, banks and healthcare systems will be able to ensure the security and protection of gathered personal data. Items composing HC construct were prepared based on extensive literature review of medical research papers (e.g. Foster & Jaeger, 2007; Katz & Rice, 2009; Rotter, Daskala & Compano, 2008) and they measure possible threats of RFID-SM usage. BIU reflects four different possible types of the RFID-SM usage (healthcare purposes, for identification purposes, for shopping and payment, and for everyday home usage) as pointed out in the interviews. The exact items wording can be found in Table 1.

AS noted above, each model component was measured by several items (Table 1). The items of HC, PT, the last item of PU, and PEU were measured on a 5-point Likert-type scale of agreement; the first six items for PU were measured on a 5-point Likert-type scale of acceptability, while the items of BIU were measured as dichotomous variable (yes/no).

Research hypotheses are presented in Figure 1. We proposed ten hypotheses. Nine of them were adopted from the 2014 study, and one new was added. We assumed that perceived experience on implantation procedure (“implanting RFID-SM is a painful procedure”) has a positive impact on HC. The predicted relationships among concepts included in the model are presented with arrows, where a plus sign (+) represents positive impact and a minus sign (-) negative impact.

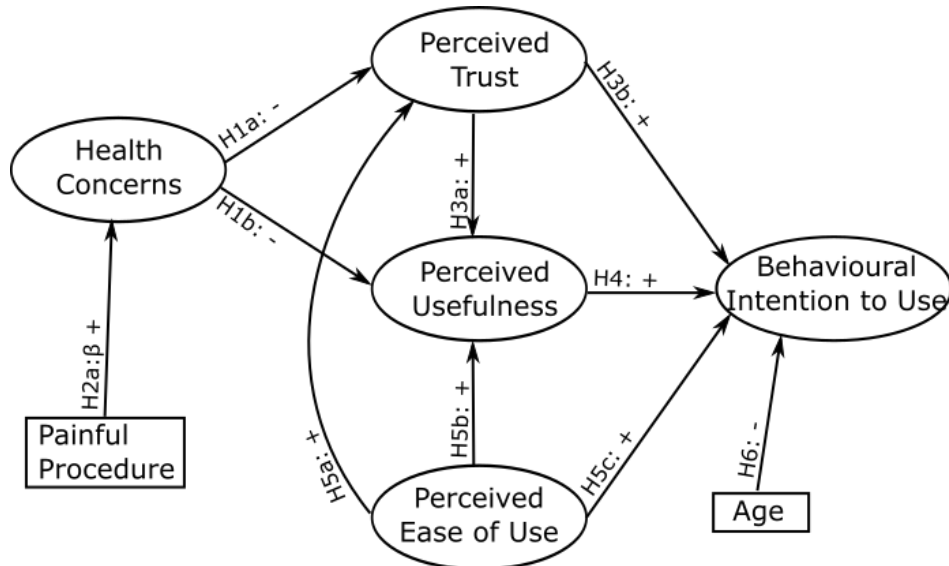


Figure 1: Research hypotheses

3.3 Data analyses

The proposed hypotheses in the research model were analysed with structural equation modelling (SEM). In this paper, presented results were obtained based on the analyses of 291 respondents, who provided at least partial responses on the variables included in the model (252 responses were complete). There is no general recommendation on minimal sample size required for SEM. Hair et al. (2006) suggested the sample size between 150 and 400, while Loehlin's rule of thumb (Siddiqui, 2013) suggests that the sample size should be at least 50 more than eight times the number of measured items in the model. Since our model consists of 25 measured variables, the minimal sample size should be 250, which indicates that the analysed sample size of 291 respondents is sufficient to achieve the statistical power necessary for SEM with three or more measured items per latent variable. To use all, also partial information obtained from the respondents, multiple imputations was used when analysing the data in order to improve the validity of the results (Mackinnon, 2010).

The research model was evaluated in two steps. First, measurement model was investigated, followed by the analyses of the structural model (Kline, 2011). To confirm, that the constructs are correctly defined, first data screening and confirmatory factor analysis (CFA) was performed, followed by SEM. Our hypotheses assume several relationships between variables which could be analysed with several multiple regressions, but SEM was employed for its ability to analyse relationships between latent and observed variables simultaneously (Teo, 2011). Several statistics were calculated before SEM, and the detailed results are omitted due to limitation of the paper length.

Here, we will only list the performed analyses to justify the corrections of the data analyses and results presented.

To assess whether the data are approximately normal and therefore appropriate for CFA and SEM, the absolute values of skewness and kurtosis were calculated. The Cronbach's alpha coefficients were calculated for each of the five constructs in our research model to determine the extent of the internal reliability. The construct validity of each scale was assessed using CFA, and it was evaluated via the convergent validity and the discriminant validity. The convergent validity was examined based on three concepts (Fornell & Larcker, 1981; Koufteros, 1999): a) estimates of the standardized factor loadings which should exceed 0.5 (or even 0.7), b) composite reliability (CR) for each latent variable which should exceed 0.7, and c) average variance extracted (AVE) measuring the amount of the common variance between the indicators and their construct in relation to the amount of variance attributable to measurement error for each latent variable, which should exceed 0.5. In order to investigate the discriminant validity of the measurement model, the square root of AVE of each latent variable was compared to the correlations between the latent variables.

In the final step, to evaluate the impact of proposed relationships among constructs in the research model, SEM was used. Since there are endogenous (dependent) binary variables in the model, the robust weighted least squares mean and variance-adjusted (WLSMV) estimation in the lavaan R-package was used (Rosseel, 2014).

In order to assess the fit of the measurement model and the structural model, the overall fit was examined based on various sets of commonly-used fit indices: χ^2/df which should be lower than 3 (Teo & Zhou, 2014); indices TLI and CFI which should be at least 0.9 in order to indicate adequate model fit (Koufteros, 1999). The root mean square error of approximation (RMSEA) should be below 0.06 (Teo & Zhou, 2014) or at least below 0.08 as proposed by (MacCallum, Browne & Sugawara, 1996).

Results of the SEM analysis are presented in the Results section. The values of standardized path coefficients (β) and corresponding z-values reflect the relationships among the latent variables in terms of the magnitude and statistical significance. For every endogenous latent variable the coefficient of determination (R^2) is also calculated, which should be above 0.1 (Escobar-Rodriguez & Monge-Lozano, 2012) to confirm the predictive capability of the model.

4 Findings and results

4.1 Sample characteristics

The sample consists of 59% of women and 41% of men. Among the respondents, 33% are in primary school, secondary school or at the university. More than half of the respondents (54%) are employed, 6% are unemployed, while 7% are retired. The age of

the respondents ranges from 11 to 79 years, with an average age of 35.7 years and $SD = 15.0$ years.

4.2 Descriptive statistics of the questionnaire items under study

Table 1 presents descriptive statistics (mean (M) and standard deviation (SD)) of 24 variables included in the research model.

On average, respondents agree the most with the statement that subcutaneous microchips can integrate multiple functions at the same time ($M = 4.02$). If we examine the four items of HC closely, we can see that respondents are worried due to treats of possible allergies ($M = 3.27$), and an impact on the nervous system ($M = 3.14$). On the other hand, they are less concerned due to possibility of microchip movements in their bodies ($M = 2.97$) and due to effects on emotional behaviour ($M = 2.95$).

Items of BIU were measured as dichotomous variables. In Table 1 the percentages of the respondents who positively answered on the individual question are presented. The highest proportion of the respondents (43%) would insert an RFID-SM for health care purposes and the smallest proportion of the respondents (20%) would have microchips for shopping and payment in a way that microchip would replace debit cards, credit cards, and profit cards.

The means were calculated also for four components. Mean values are above 3 for three components: 3.08 for HC, 3.76 for PEU, and 3.46 for PU, which indicates that the overall response could be classified as positive. The mean of PT is equal to 2.71, which indicates that perceived trust on security issues provided by state, banks, and healthcare system is somehow low.

Table 1: Descriptive statistic of the questionnaire items

Model comp.	Questionnaire items	N=291	
		Mean	SD
Health Concerns (HC)	Subcutaneous microchips can be threatening to my health because of the possibility of movement in my body. (HC1)	2.97	1.187
	Subcutaneous microchips may affect my emotional behaviour (control of human behaviour, etc.). (HC2)	2.95	1.265
	Subcutaneous microchips can be threatening to my health because of possible allergies. (HC3)	3.27	1.196
	Subcutaneous microchips can be threatening to my health because of their impact on the nervous system. (HC4)	3.14	1.206
Perceived Trust (PT)	The state will ensure the security and the protection of human rights (security of identity documents, passport, identity theft, tracking via GPS, no records should be archived without the consent of the person observed). (PT1)	2.57	1.271
	Banks will provide security (payment, discretion of operation, transactions, etc.). (PT2)	2.70	1.297
	The healthcare system will provide security (personal data, medical data, information on treatments, organ donation, etc.). (PT3)	2.84	1.29
Perceived Usefulness (PU)	Subcutaneous microchips could be used:		
	for monitoring the health of the user, e.g. pulse or blood pressure. (PU1)	3.60	1.127
	for warning about potential health problems or complications (e.g. diabetes). (PU2)	3.73	1.09
	for storing medical info for accident or emergency. (PU3)	3.64	1.097
	for personalized health info. (PU4)	3.21	1.198
	for storing information about organ donation. (PU5)	3.21	1.2
	Users of the subcutaneous microchips should have lower health insurance premiums. (PU6)	3.03	1.246
Subcutaneous microchips may save your life (e.g. unconsciousness, cardiac pacemaker, sugar detector, insulin dispenser, etc.). (PU7)	3.81	1.066	
Perceived Ease of Use (PEU)	Subcutaneous microchips are always available. (PEU1)	3.53	1.117
	Subcutaneous microchips cannot be lost. (PEU2)	3.79	1.068
	Subcutaneous microchips cannot be stolen (high-security protection). (PEU3)	3.18	1.317
	Subcutaneous microchips can integrate multiple functions at the same time. (PEU4)	4.02	0.888

Painful Procedure	Implanting RFID-SM is a painful procedure.	2.89	1.167
	Would you insert a subcutaneous microchip:		Percentage of positive responses
Behaviour Intention to Use (BIU)	for healthcare purposes (identification, storage of medical data, information on organ donation, etc.)?	43%	
	for identification purposes (ID card, passport, driving licence, etc.)?	28%	
	for shopping and payment (debit cards, credit cards, profit cards, etc.)?	20%	
	for everyday home usage (unlocking house or apartment, car, computer, mobile phone, etc.)?	23%	
	if you were assured that GPS positioning and tracking were not possible?	29%	

4.3 Results of the SEM

First, measurement model was evaluated. The item PEU3 on RFID-SM security protection was removed from the PEU construct, and consequently from the model, due to combination of its standard loading slightly above 0.5 (0.515) and its variance which was twice as big as for other construct items. Standardized factor loadings for items in the (final) model exceed a threshold of 0.5 for convergent validity, 19 of them exceed also stricter threshold of 0.7. The AVE for all five constructs reach and exceeds a threshold of 0.5 for convergent validity (HC 0.53, PT 0.74, PEU 0.50, PU 0.54, BIU 0.85).

In our measurement model, the obtained value of $\chi^2/df = 1.465$ ($\chi^2 = 291.502$, $df = 199$) is lower than 3, and both TLI = 0.89 and CFI = 0.90 are close to 0.9. The RMSEA is equal to 0.040, and the upper bound of RMSEA 90% confidence interval (0.030, 0.050) is lower than 0.06. According to the set of the calculated fit indices, it could be concluded that measurement model fits the sample data reasonably well. Therefore, the fit of the structural model could be evaluated.

The goodness-of-fit of the SEM was evaluated with the same set of indices as for the measurement model. The results show that the model has a good fit: $\chi^2/df = 2.154$ ($\chi^2 = 523.343$, $df = 266$), TLI = 0.88, CFI = 0.89, and RMSEA = 0.063 with its 90% confidence interval (0.056, 0.070).

The results of the structural model are presented with standardized path coefficients (β) (and corresponding z-values), which reflect the strength of the relationships among the latent variables (Figure 2).

For every endogenous latent variable also the coefficient of determination (R^2) is presented. The predictive capability of the model is satisfactory because all coefficients of determination (R^2) are above 0.1. The smallest R^2 is for HC and it is equal to 0.246, R^2 for PT is 0.278, for PU is equal to 0.514, and the highest value of R^2 is for BIU (0.578).

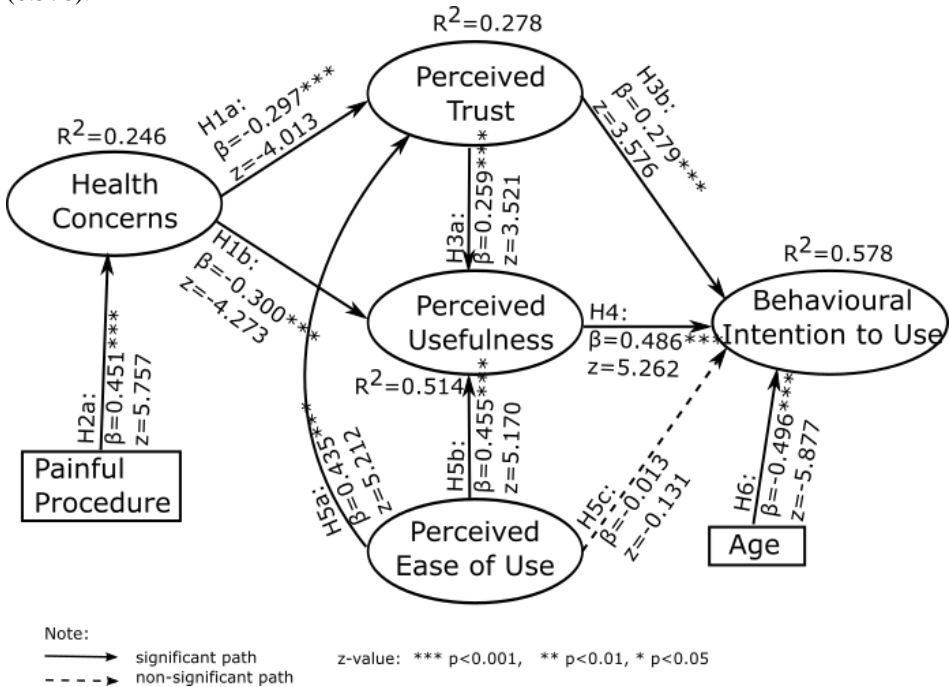


Figure 2: The results for structural model

Table 2 presents overview of the results for ten proposed research hypotheses regarding their acceptance or rejections.

Table 2: Overview of the results for ten proposed research hypotheses

Hypothesis	Supported
H1a: Health Concerns has negative impact on Perceived Trust.	Supported
H1b: Health Concerns has negative impact on Perceived Usefulness.	Supported
H2a: Painful Procedure has positive impact on Health Concerns.	Supported
H3a: Perceived Trust has positive impact on Perceived Usefulness.	Supported
H3b: Perceived Trust has positive impact on Behaviour Intention to Use.	Supported
H4: Perceived Usefulness has positive impact on Behaviour Intention to Use.	Supported
H5a: Perceived Ease of Use has positive impact on Perceived Trust.	Supported
H5b: Perceived Ease of Use has positive impact on Perceived Trust.	Supported
H5c: Perceived Ease of Use has positive impact on Behaviour Intention to Use.	Not supported
H6: Age has positive impact on Behaviour Intention to Use.	Supported

We can see from Figure 2 and Table 2 that based on the values of the standardized path coefficients and the corresponding z-values nine out of ten hypotheses were supported. Details are discussed below.

Basic TAM model proposes three positive relationships among constructs. Two of them were supported, while one was rejected. The positive effects of PU on BIU (hypotheses H4) and positive effects of PEU on PU (hypothesis H5b) were supported. Hypothesis H5c regarding positive effect of PEU on BIU could not be supported. This is in accordance with the finding of the research from 2014, where this relationship has also not been confirmed. That result shows that ease of use is not an important predictor of BIU. If the respondents find the microchips useful, then they would implant them regardless their availability and handiness.

The impacts of Age on BIU and of the Painful Procedure on HC are the strongest in the model. The variables PU and BIU have three significant predictors that can explain 51% and 58% of its total variance, respectively.

HC have a negative effect on both PT and PU (hypotheses H1a and H1b), where the impact is slightly stronger to the PT. PT has a positive impact on PU (H3a) as well as direct effect on BIU (H3b). As expected, Age has a strong direct negative impact on BIU (hypothesis H6).

5 Conclusion

Since most of the research has studied the willingness to adopt RFID-SM technology from the viewpoint of providers (e.g. Hospital management), and only a few studies dealt with end-user willingness to adopt RFID-SM, we decided to research this gap in 2014.

Due to the high frequency of technological advances, we have repeated and extended our study in 2016. The latter results are presented in this research paper.

The research topic is rather delicate. There are ethical questions whether or not should we put something unnatural under our skin. Hundreds of deaf people with hearing implants will surely not reject interventions in their bodies to enable their hearing. The same goes for patients with cardiac pacemakers and diabetes patients. There are thousands of orthopaedic patients with different implants. In the first research, back in 2014, no statistically significant correlations between the attitude towards earrings, piercing and tattoos and willingness to use RFID-SM existed. Although we would expect that the people willing to puncture their skin just to change their appearance, would also be prone to RFID-SM if they find the advantages of such system inspiring.

Most of the researched items showed a slightly more positive attitude towards the RFID-SM than two years ago. In addition, people are less concerned, since all items on Perceived Trust have higher average values. In addition, the recent results again showed that Perceived Ease of Use does not have a statistically significant influence on the Behaviour Intention to Use. The fact the implantation of RFID-SM is a painful procedure, positively influences the concept of Health Concerns. Although the Perceived Trust has slightly raised, Health Concerns are still evaluated as significant predictor of Perceived Trust and Perceived Usefulness. The result showed that the attitude towards the RFID-SM implantation is still negative. The respondents probably do not realize that most of the medical implants work the same way as an RFID-SM.

According to the results, most of the issues on RFID-SM adoption perceived by the end users are slowly losing their importance. Due to different reasons, public has become more open to the possibility of using the RFID-SM for different purposes. Therefore, more studies on the safety of RFID-SM should be conducted. New, preferably less invasive ways to enable a unified personal identification should be proposed.

This paper presents only the results of the survey conducted in Slovenia, therefore, our further research will include the results of the surveys gathered in other European countries to establish whether similarities in the attitudes toward RFID-SM adoption exists. A general extended TAM model for the intention to use the RFID-SM will be generated, where also an impact of privacy rights and privacy threats on Perceived Trust and indirectly on Behaviour Intention to Use will be examined.

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Customer Context and Social CRM: A Literature Review and Research Agenda

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Abstract Social Media have emerged as further source of information for businesses. Data from Social Media have the potential to enable companies in better understanding and serving their customers. This requires the combination of two perspectives – the inside-out view underlying traditional CRM applications on the one and the out-side-in view inherent in the rather dynamic and situation-specific data from e.g. So-cial Media on the other hand. The latter form the basis for understanding customer context, which is explored in this paper. This paper contributes to existing research by developing a customer context model and related information through conducting a structured literature review. It then proposes a matching of Social Media data from Twitter to the model and discusses available data sources of context information. The overall aim is to support customer-dominant business strategies by building up on the Social CRM approach.

Keywords: • Customer Context • Customer-dominant Logic • Social Media • Social Customer Relationship Management •

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1 Introduction

The use of Social Media has increased considerably within the last years. Today, social networks such as Facebook and Twitter report 1.8 billion respectively 320 million active users (Facebook, 2017; Twitter, 2017). Users of these networks not only share their opinions on products or companies or complain about products or services. They also share personal information that are potentially relevant for an interaction with companies (Heller Baird & Parasnis, 2011; Kaplan & Haenlein, 2010; Woodcock, Green, & Starkey, 2011). For companies, using information from these sources might be valuable since they originate directly from the customers them-selves. This development drives the necessity to automate the acquisition and pro-cessing of social data and to integrate it with Customer Relationship Management (CRM) applications. This interconnection of Social Media on the one and CRM appli-cations on the other hand is referred to as Social CRM (Alt & Reinhold, 2012). This concept is a means to meet the personal agendas of a company's customers (Greenberg, 2010) and therefore requires personalization based on additional cus-tomer information.

As today's customers expect collaborative and personalized interactions with com-panies (Baumöl, Hollebeek, & Jung, 2016) most businesses declare customer-orientation as a part of their business strategy (Alt, 2016). However, there are two different notions of customer-orientation, a seller and a buyer perspective, and this research adopts the latter, which refers to the customer and his respective benefits. This perspective is also named outside-in (buyer) perspective and contrasts the in-side-out (seller) perspective (Saeed, Yousafzai, Paladino, & De Luca, 2015). This paper suggests that context information are an adequate and promising means to satisfy this expectation and to understand the higher-order needs of a customer. Context is relevant to many interaction scenarios between providers and consumers (Adomavicius, Mobasher, Ricci, & Tuzhilin, 2011; Dey, 2001) and might lead to a new understanding of the customer, who actively influences and orchestrates the configuration of products and services across multiple providers (Reinhold, Wittwer, Alt, Kirsten, & Kiess, 2017).

In addition, the current paper adopts the perspective of customer-dominant logic (CDL), an approach that places customers in the center of business activities and pursues an outside-in perspective. This requires that businesses understand their customers in terms of their respective situation that usually is not part of classical CRM applications. This paper argues that highly relevant information can be cap-tured from additional data sources, such as Social Media. As there is relatively little research on customer context, this paper clarifies the term, derives a customer con-text model for Social CRM from literature and complements this model with specific context elements. Hence, the following two research questions are formulated:

- RQ1: How can the term context be defined from a customer's perspective?
- RQ2: Which context elements and data sources are relevant within a Social CRM?

To answer the research questions, two research methods are applied: First, a structured literature review was conducted in order to clarify both the term customer context and its constituents and to finally derive a context model. Second, a mapping of the constituent context elements with Social Media data is provided. To achieve the research aim, the paper is structured as follows: The second chapter introduces the conceptual foundations, i.e. the CDL and Social CRM. Thereafter, chapter three presents the literature review and derives the model as well its elements and finally describes the matching. Chapter four discusses the findings and, finally, the paper concludes with a summary and the formulation of future research questions.

2 Conceptual foundation

2.1 Customer-dominant logic

The term and concept of CDL originated from the fields of relationship marketing and service research (Heinonen et al., 2010). Compared to other approaches, such as the service-dominant logic (SDL), CDL is a perspective on business from a customer's viewpoint and therefore emphasizes how customers embed services (or products) in their lives rather than how businesses can provide services to customers (Heinonen & Strandvik, 2015). CDL therefore answers the question "What can we offer to customers that they are willing to purchase and pay for?" instead of asking "How can we sell more of our existing offerings?" (Strandvik, Holmlund, & Edvardsson, 2012). In order to answer this question, businesses need to apply adequate methods to understand customers and their logic.

The concept of CRM, which is a combination of customer-oriented strategies and technologies, aims at long-term profitable relationships (Greenberg, 2010) and offers means (e.g. customer segmentation and analytics, campaign management) to better understand customers. However, CRM systems offer an inside-out view on a customer, i.e. they create customer profiles (cf. Neckel & Knobloch 2015) that hold information (i.e. action data, reaction data, personal data, and potential data) about customers (cf. Neckel & Knobloch 2015; Reimer & Becker 2015) that are known to a company from past interactions. A complementing approach is the outside-in view as mentioned before which contributes information from the customers themselves and therefore complements classical customer profiles. This view might also contribute to a firm's competitive advantage as market requirements can be anticipated ahead of competitors (Day, 1994). Hence, traditionally stored customer information (inside-out view) is rather static and needs to be complemented by rather dynamic information (outside-in view). These initial considerations drive the need to enhance the concept of a CDL by proposing the application of a deeper understanding of the customer.

2.2 Social Media and Social CRM

Social Media can be defined as web-based internet applications that allow the creation, access, and exchange of user-generated content (Greenberg, 2010). Kaplan and Haenlein (2010) propose a classification for Social Media which encompasses among others social networking sites (e.g. Facebook) and micro blogs (e.g. Twitter). Facebook and Twitter are amongst the largest Social Media and contain millions of public postings each day. These channels represent platforms for the information exchange between customers and are therefore a valuable source of customer and context information. For example, a single tweet delivers up to 60 different attributes that help in further enriching CRM data with information provided by customers themselves (e.g. their current situation, needs or problems).

The term Social CRM denotes a customer-oriented concept that integrates Social Media with CRM applications and thereby opens a broad spectrum of potential use cases in the area of marketing, sales and service (Greenberg, 2009; Alt & Reinhold, 2012). Among the examples are to derive knowledge on target customers and influencers or on product improvements as well as online customer interaction. It therefore widens the understanding of classical CRM applications as it includes the outside-in perspective on a customer. An important element of Social CRM is the integration of unstructured data from the social web, such as product- or brand-based data and further context elements. This requires techniques for monitoring and analyzing social content and integrating results into CRM processes. In this context, Reinhold and Alt (2012) proposed five task areas as elements of an integrated Social CRM. Here, Social Media Monitoring forms one of the components and aims at automatically identifying business-relevant information. The related monitoring steps (cf. Bengston et al. 2009; Bruns & Liang 2012; Stavrakantonakis et al. 2012) and their respective outcomes (cf. Stieglitz et al. 2014; Zhang & Vos 2014) are described and further consolidated in literature (Wittwer, Reinhold, & Alt, 2016).

3 Elements of a customer context model for Social CRM

3.1 Defining customer context

The literature review followed the methodology suggested by vom Brocke et al. (2009), which comprises the steps (1) defining the review scope, (2) conceptualizing the topic and (3) the literature search itself. Starting with the first step, the scope of the literature review followed Cooper (1988, cf. Table 1) and focused on research outcomes and theories (i.e. definitions and elements). It aimed at the integration of existing knowledge and was conceptually organized to cluster similar works. The perspective may be characterized as a neutral representation for both specialized scholars as well as practitioners as the target audience. The results are finally representative for the IS community as respective data sources were queried.

Table 1: Characteristics of the literature review

Characteristic	Categories			
Focus	research outcomes	research methods	theories	applications
Goal	integration	criticism		central issues
Organization	historical	conceptual		methodological
Perspective	neutral representation		espousal representation	
Audience	specialized scholars	general scholars	practitioners	general public
Coverage	exhaustive	exhaustive and selective	representative	central / pivotal

The keyword search (cf. Table 2) was performed on the databases of EBSCO, IEEE, and ScienceDirect in title (TI), publication title (PT), abstract (AB), and keywords (KW). The first search string (steps 2 and 3) (“customer context”) was supplement-ed with the terms “consumer context” and “patient context” as the initial number of search results was low (22). Only reviewed contributions published since the year 2000 and such that are written in English language were considered in order to en-sure transparency of results on the one hand and currentness on the other hand. The number of search results for all three keywords and the named restrictions was 146 and formed the basis for a deeper analysis. Each publication was screened in the named fields and, if marked as relevant to the concept of customer (or con-sumer or patient) context, the full-text was read to extract relevant items. Since it was found that context may either be related with application systems or their re-spective users (customers), a further restriction was made towards the user per-spective. This view aligns with the CDL perspective as it helps businesses to under-stand customers and their individual, situation-based needs.

Table 2: Results of the literature search

Databases	Search fields	Keywords		Number of results		
		A	B	C	Initial	Evaluated
EBSCO	TI, AB, KW	14	54	2	70	5
IEEE	TI, PT, AB, KW	2	7	13	22	1
ScienceDirect	TI, AB, KW	6	29	19	54	8
Total	-	22	90	34	146	14

After screening all publications, the relevant contributions to the understanding of customer context were selected (14). While analyzing the papers in detail it was found that they contribute to either a definition, the understanding of elements or a classification of the latter. The following table presents the resulting papers and indicates their main contribution.

Table 3: Context definitions, elements and dimensions from the literature review

Author(s)	Context definition	Context elements	Context dimensions
(Helgason & Jobe, 2006)	<i>"(...) objects of interest or quantities which potentially can take on different numerical or other values."</i>	-	Biologic make up, history, environment
(Bose & Chen, 2009)	<i>"(...) services, which take into consideration the context data of consumers such as time, location etc."</i>	Location/position, time, mobile technology	-
(Gard & Kring, 2009)	<i>"(...) where participants were; who participants were with; what participants were doing (...)"</i>	-	Describe environmental contexts of schizophrenia patients as where participants were, who participants were with, and what participants were doing
(Griffin & De Leatar, 2009)	<i>"An adaptation of the presence mechanism to convey patient context derived from smart devices."</i>	Blood sugar level	-

Author(s)	Context definition	Context elements	Context dimensions
(Sannino & De Pietro, 2011)	<i>“(…) patient context means patient posture, movement, breath, temperature etc.”</i>	Patient posture (lying, standing), movement (walking, running), breath, temperature, heart rate (min, max, threshold), time/interval	-
(Haas-Kotzegger & Schlegelmilch, 2013)	-	Product knowledge, prior experience, perceived geographical distance	-
(Steel, Dubelaar, & Ewing, 2013)	<i>“(…) stimuli and phenomena that exist in the environment surrounding an individual or operational unit that has an impact on the individual or unit and can limit or provide opportunities for behaviour and attitudes in an organisational setting.”</i>	-	-
(Kristina Heinonen, 2014)	<i>“What are customers doing?”, “(…) what customers do and experience in their own lives and businesses beyond service offerings (…)”</i>	-	-

Author(s)	Context definition	Context elements	Context dimensions
(Pappachan, Yus, Joshi, & Finin, 2014)	-	Age/age group, gender, location (city, state, location), profession, diseases in the area, symptoms, activity	-
(Chou, Chen, & Conley, 2015)	“(…) <i>specific customer needs and values (…)</i> ”	-	-
(Nemoto, Uei, Sato, & Shimomura, 2015)	“(…) <i>a set of spatial-temporal elements related to the person or product. In addition, these spatial and/or temporal elements are called contextual elements (…)</i> ”	Personalities, knowledge, skills, relationship with others, social trends, economic circumstances, technology direction, public consciousness, health conditions, humors, emotions, behaviors, season, location, weather, temperature	Environment attributes, customer attributes, environment states, customer states
(Boulemtafes, Rachedi, & Badache, 2016)	-	Available (medical) resources (devices), location, constraints impacting a user’s mobility, available communication networks, sensing infrastructures	-
(Kahveci, Yuksel, & Laleci Erturkmen, 2016)	-	Current medication, medical history, tests, allergies, reactions, drug therapies	-

Author(s)	Context definition	Context elements	Context dimensions
(McHeick, Nasser, Dbouk, & Nasser, 2016)	-	Blood pressure, carotid stenosis, symptoms, age, speech impairment, unilateral weakness	-

The results in the table show that solely one research paper provides besides a definition of context also dimensions and associated elements (cf. Nemoto et al., 2015) whereas most papers (8) provide information on solely one of these aspects. Both context dimensions as well as models are sparsely described in current research as indicated above. Definitions of context are applicable to different spheres of life and are either comparatively broad or enumerative and therefore do not foster a common understanding of the term. However, there are papers that consider the customer and his environment as relevant components of context (Gard & Kring, 2009; Nemoto et al., 2015; Steel et al., 2013) which aligns with the customer-centered view of context within this paper. In addition and from a Social CRM perspective, context is conceived as additional information originating from the customer (e.g. through analyzing Social Media), which is called outside-in perspective in the following. It furthermore intends to supplement the existing inside-out view on a customer (e.g. customer profiles within CRM applications). Therefore, this research defines customer context as customer-centered, dynamic and domain-independent information that might be used in different spheres of life (e.g. mobility, health) and provide additional information about the customer and his environment. Given this definition, a further specification of context by defining its constituents is necessary and described in the following.

3.2 Structuring customer context

In addition to the above-mentioned definitions of context, literature also provides a framework for structuring customer context respectively describes specific context elements. For this research, the schema of Nemoto et al. (2015) fits best as it is the only framework that suggests context dimensions, clusters context elements within these dimensions and aligns with the view on the customer and his environment. The other papers found mainly discuss definitions and elements and only a few (three, cf. Table 3) mention related context dimensions. The resulting model (Figure 1) summarizes context elements provided in the reviewed literature and is extended by examples for each element. It has to be considered that the given list of context elements is not exhaustive. However, the model differs the two before mentioned perspectives on context information, i.e. the customer and his environment. The characteristics of these information are furthermore distinguished into individual or global on the one and long-term or short-term validity on the other hand (Nemoto et al., 2015). With regard to a Social CRM system, individual context information belong to a specific customer whereas global information form the basis for describing customer segments. Gathered

context are grouped into rather short-term or long-term valid information and therefore signals either a temporary interaction opportunity (e.g. based on the location and preferences of a customer) or a general market demand (e.g. based on a community's demand).

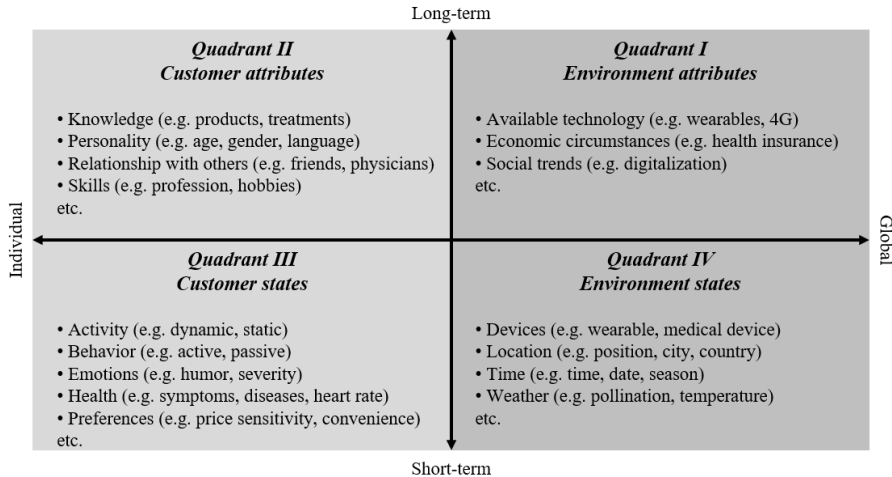


Figure 1: Customer context model for Social CRM (based on Nemoto et al., 2015)

With regard to customer profiles, the attributes in the model describe the before mentioned action, reaction, personal and potential data and enable businesses to complement or enrich their customer profiles. This serves as a basis for Social CRM processes such as for example customer segmentation and campaign management. Within a Social CRM the most relevant source of data are Social Media as they enable businesses to get closer to the customer than ever before (Alt, 2016) and provide a rich set of data about customers and customer segments. Wearables, such as smart watches, are a second source of information. They deliver relevant user-centered information such as pulse rate, activity level, pedometer, altimeter, location, time, distance, or temperature. Especially health-related information from those devices are regarded as an addition to specific medical devices, such as heart rate monitors, which are a further source of information and may possess a higher accuracy of data capturing as they are calibrated and approved.

3.3 Context elements from Social Media

With regard to a Social CRM application, two principle methods of context information acquisition may be distinguished (Reinhold et al., 2017). The first method is a direct user input as a response to an input prompt. This may be the case when a customer inputs information himself, for example in order to search or configure a service offering (e.g. mobility services such as Quixxit, Outfittery). The second method is an indirect user

input, which gathers data with or without a customer’s knowledge. This may be the case when mobile applications automatically collect e.g. location data in order to offer relevant mobility services. This research focuses on the latter and assumes a conscious transfer of context information from a customer towards a company. In this setting, a customer is aware that certain data may be transferred.

Capturing context from Social Media refers to the second method and may either be performed by using a social network’s application programming interface (API; “mined context”) or by using specific Social CRM applications (such as Social Media Analytics, Monitoring or Text Mining applications) or external service providers such as Google Fit (“derived context”; Henricksen et al., 2005). For example, using the Twitter API delivers the name of a user and the raw text of a tweet. Applications of Social Media Monitoring and Analytics on the other hand aggregate and interpret available context information and are able to create further information that were not available from the API. For example, based on a user’s tweets SMA applications provide an overview about different topics a user is interested in and his attitude or sentiment towards these topics. Figure 2 summarizes both methods to capture context information from Social Media.

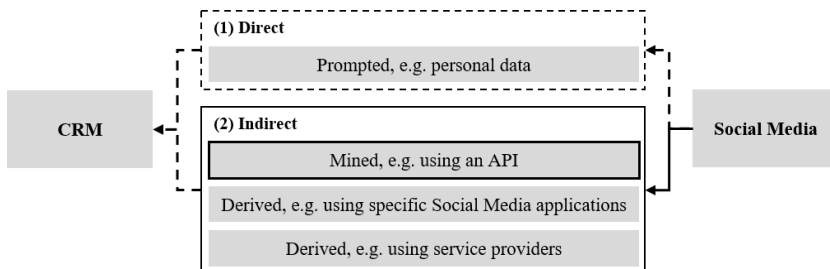


Figure 2: Methods for capturing context from Social Media

The following table presents the results of a mapping between context elements from the model (see Figure 1) and available context information from the Twitter API. The matching refers to the indirect and mined method of capturing context information (see the highlighted path in Figure 2) and was conducted by reviewing all available attributes from the Twitter API and assigning them to a suitable context element in the model based on the attribute’s description in the API. The table presents directly available data elements, which are mainly related to the context dimensions 2-4 (first column). The contained information might be enriched by applying e.g. SMA or Business Intelligence applications (cf. Wittwer, Reinhold, Alt, Jessen, & Stüber, 2017). However, especially for the first context dimension (environment attributes) the derivation of information is necessary in order to obtain further insights.

Table 4: Directly available context information from Twitter

Context dimensions	Context elements	Available attributes from Twitter
Environment Attributes	Social trends	<i>(requires deriving further context information using Social CRM applications)</i>
	Economic circumstances	
	Available technology	
Customer Attributes	Personality	<i>User name, preferences, language, timestamp, user description, verification status</i>
	Knowledge	<i>Listed count</i>
	Skills	<i>User description</i>
	Relationship with others	<i>Contributors, favorite count, favourites count, followers, friends count</i>
Customer States	Health	<i>Text, user description, hashtags</i>
	Emotions	<i>Text, user description, hashtags</i>
	Activity	<i>Text, coordinates, place, description, statuses count, hashtags</i>
	Behavior	<i>Text, statuses count</i>
	Preferences	<i>Text, profile background color, description, hashtags, media</i>
Environment States	Devices	<i>Text, named entities, hashtags</i>
	Time	<i>Coordinates, time zone</i>
	Location	<i>Coordinates, place, named entities, hashtags</i>
	Weather	<i>Coordinates, place, hashtags</i>

Based on the model and using the Twitter API, a software implementation could extract the given information and build a specific context model. By extracting further tweets from an individual, the model gradually completes. For example, the tweet text might reveal information on an individual's emotions, preferences as well as interests and thereby frame his "customer states". In addition, information such as coordinates and

time zone indicate the residence or whereabouts and frame the “environment states”. Finally, the user name, language and user description frame “customer attributes”.

4 Discussion

Following Heinonen and Strandvik (2015), the essential features of CDL are the business perspective, customer logic, offerings, value formation, and customer eco-systems. The results of this research contribute especially to the understanding of the customer logic and therefore improve the relevance of product or service offer-ings.

Current research falls short in providing a common understanding of customer con-text with a structured collection of related context information and the instantiation with Social Media data. Therefore, this paper complements existing research by ad-dressing these aspects. As a first result and with respect to RQ1 this research pre-sents a definition of customer context in Social CRM settings and provides a concep-tual model to structure the concept and its constituents. As a second result and re-ferring to RQ2, the model is adapted with a non-exhaustive list of context elements found during a literature review. It builds on the results from multiple research disci-plines (information systems, marketing and management, and healthcare) and therefore aims to be applicable to multiple spheres of live, e.g. mobility, communi-cation, and health. The paper then discusses several data sources of context infor-mation (RQ2), focusing especially on Social Media as a rich data source. The pro-vided mapping shows that relevant context information are available within Social Media and relates them to the model.

These results are discussed together with a CDL perspective on customer relation-ships. In CDL as a marketing perspective, customer logic is a concept describing a customer’s activities, experiences, and goals (Heinonen et al., 2010). Each custom-er’s logic is individual, can change and may be influenced (e.g. by others or external effects) or may change over time. Within a Social CRM, customer context is a spe-cific and structured enabler that helps businesses to understand this customer logic as it captures individual information, especially from Social Media, either by sensing or deriving context information. Customer context extends the often stressed 360° view on a customer (Chen & Popovich, 2003; Sussin, Friedman, & O’Kane, 2015; van Looy, 2016) by incorporating outside-in data with existing inside-out data and thereby puts the customer at the center of business activities. As a result, it is the basis to enable a cross-provider understanding of customers. This research provides the starting point for individualized, customer-centered Social CRM processes based on the captured data from Social Media. The described context information might be used in Social CRM processes, such as the definition of personas, which represent specific needs, characteristics, or preferences of a target or target group or within a so called “social customer value dashboard”, which contains weighted context ele-ments that calculate to a sum and provide information about the relevance of an offering for a target or target group. This briefly illustrates practical and exemplary application perspectives of the concept within a CDL strategy.

Ultimately, these re-sults form the basis for businesses to answer the initially raised question “What can we offer to customers that they are willing to purchase and pay for?”.

5 Conclusions and outlook

This research presents an analysis of current literature on customer context. It de-rives a definition of context, a model, context dimensions as well as specific context elements from literature in order to substantiate a common understanding of the concept for Social CRM. Thereafter, the paper describes a mapping of context ele-ments with Social Media data using Twitter as an example. As business environ-ments are increasingly competitive, the need to understand customers and their in-dividual logic is an inevitable success factor for them. Methods and sources for the collection of context information are discussed and it is postulated that especially Social Media deliver a large amount of data (besides e.g. wearables and medical devices) that may help to transform a company’s inside-out perspective towards an outside-in perspective.

However, the following considerations reflect on the limitations of this research and thereby formulate a short exemplary research agenda, which shall be addressed by future research. The aspects reflect on the application of the concept, the investiga-tion of benefits for both customers and businesses and the necessity to control the access to context information:

- First, it is necessary to further research on the proposed model’s applicability to service (or product) providers and extend the given list of context infor-mation. Furthermore, an application of the model to other application fields, such as medicine, shall be addressed and could be beneficial. With respect to the openEHR standard (openEHR Foundation, 2017) for Electronic Health Records (EHR) possibly valuable (patient) context information could supple-ment clinical information such as basic information, medications list, thera-peutic precautions and the social situation. For example, using a case study approach could identify further context elements and application fields of rel-evance.
- Second, further research also needs to answer the questions of how to mod-el and digitally represent context information. For example, XML notations and annotation models (e.g. W3C Web Annotation Data Model) may be a suitable digital representation of context information to be exchanged be-tween application systems, such as Social CRM and recommender systems.
- Third, research needs to address the resulting benefits that may arise from the incorporation of customer context into product or service offerings (or medical treatments) from both a company’s and particularly from a custom-er’s perspective. For example, a presumable selling potential could be based on a specific demand.
- Finally and within such a customer-centered and data-based business strate-gy, privacy aspects are highly relevant and need to be considered by further research. The argumentation of this research is based on the assumption that

publicly available data can be used within a business context but rising questions on privacy, data sovereignty, data usage, and data control still have to be answered to prevent a misuse of social data which entails latent risks e.g. for personal rights (Alt & Reinhold, 2016). With regard to the data control aspect, a proposed solution is a customer-owned “context app” which provides a central control mechanism to the user. For example, a customer could decide selectively, e.g. during a service configuration process, which additional context information he will provide in order to configure a service congenial to his need.

With the rising use of Social Media on the one and the also rising demand of collaborative and personalized interactions with companies on the other hand, the latter need to apply methods to better understand their customers. Customer context (from Social Media) is a promising means to achieve this aim as it helps to understand customers and their respective needs. It therefore helps to bring customers and companies closer together.

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ERP Solution Acceptance by Students

SIMONA STERNAD ZABUKOVŠEK & SAMO BOBEK

Abstract ERP acceptance by its users in companies has been researched by several authors while ERP acceptance by students within study programmes has not been researched so often. For teachers should be important to know which factors have influence on student ERP acceptance. Our study researches student acceptance of ERP solutions while they are exposed to ERP solution and they are involved in ERP actual use. Our research is based on TAM which provides a basis for tracing impact of external factors on internal beliefs (perceived usefulness – PU and perceived ease of use – PEOU), attitudes (AT), intentions (behavioural intention – BI) and actual use. Research model includes additional external factors such as: experience with computer, computer self-efficiency, personal innovativeness toward IT, computer anxiety, user manuals (help), system quality, social influence (environment), training and education etc. Research was conducted within a group of 121 students after short interaction with Microsoft Dynamics NAV ERP solution. Results show that most important external factors for student ERP acceptance are: individual benefits, training and education on ERP system and quality of ERP system.

Keywords: • ERP solutions • students • ERP acceptance • TAM •

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1 Introduction

The most used integrated software solutions in companies from almost all industries worldwide are Enterprise Resource Planning (ERP) solutions. Number of ERP users is growing very fast and majority of employees are using ERP solutions daily at their work. Because this, on labour market is huge demand for students with knowledge of ERP solutions. In past few years, a lot of universities included topics from ERP solutions in their curriculums through different subjects such as: Accounting Information Systems, Enterprise Resource Planning, Information Systems etc.

While number of ERP solution user is growing, a lot of research studies regarding ERP user adoptions/acceptance are emerging (for example see Costa et al., 2016). The most used research models are (Awa et al., 2016): technology acceptance model (TAM; Davis, 1989), theory of reasoned action (TRA; Ajzen & Fishbein, 1980), theory of planned behaviour (TPB; Ajzen, 1991), innovation diffusion theory (IDT; Rogers, 2003), stage model (SM; Poon & Swatman, 1999), technology-environment-organization (T-O-E; Tornatzky & Fleisher, 1990); and resource-based view (Caldeira & Ward, 2003). In this area, TAM is one of the most suitable and widely used model to study adoption in IS (Shih and Huang, 2009; Sternad et al., 2011; Costa et al., 2016) and therefore numerous IS researchers apply this method to ERP research. The key purpose of TAM is to provide a basis for tracing impact of external factors on internal beliefs (perceived usefulness - PU and perceived ease of use – PEOU), attitudes (AT), intentions (behavioural intention - BI) and actual use (Davis et al., 1989).

Despite ERP acceptance by its users in companies has been researched by several authors, ERP acceptance by students within study programmes has not been researched so often. Our goal is to research external factors which influence student acceptance of ERP solutions. Our research model is based on TAM and include factors of original TAM (perceived ease of use – PEOU, perceived usefulness – PU, attitude toward using ERP system – AT, behaviour intention – BI, actual use - Use) but our research model modify external factors. We have included additional external factors which we think that will have impact on ERP acceptance: experience with computer, computer self-efficiency, personal innovativeness toward IT, computer anxiety, user manuals (help), system quality, social influence (environment), training and education etc. The research approach is based on short interaction (after 12 hours) contact with ERP solution.

The survey was conducted among group of students, who do not have any knowledge regarding ERP solutions before. After description of ERP solutions and literature review, research model is described in details and results of study are presented and discussed.

2 ERP solutions

ERP solution is usually referred to as a category of business-management software. Typically, this is a suite of integrated applications which an organization can use to collect, store, manage and interpret data from their daily business activities. ERP

solutions provide an integrated and continuously updated view of core business processes using common database. ERP solutions track business resources—cash, raw materials, production capacity—and the status of business commitments: orders, purchase orders, and payroll. The applications that make up the system share data across various departments (manufacturing, purchasing, sales, accounting, etc.) that provide the data (Almajali, Masa'deh & Tarhini, 2016). ERP facilitates information flow between all business functions and manages connections to outside stakeholders (Bidgoli, 2004). Most ERP systems incorporate best practices which means the software reflects the vendor's interpretation of the most effective way to perform each business process (Monk & Wagner, 2009).

The organization Gartner Group first used the acronym ERP in the 1990s (Wylie, 1990). ERP systems experienced rapid growth in the 1990s, because of the year 2000 problem and the introduction of the euro that disrupted legacy systems, many companies took the opportunity to replace their old systems with ERP (Monk & Wagner, 2009). ERP systems initially focused on automating back office functions (functions which did not directly affect customers), while front office functions (functions which directly dealt with customers, e-business or supplier relationship management (SRM) became integrated later, when the Internet simplified communicating with external parties. The ERP II was introduced in 2000 by the Gartner organization (Bond et al., 2000) and describes web-based software that provides real-time access to ERP systems to employees and partners (such as suppliers and customers). Their role expands traditional ERP resource optimization and transaction processing and leverages information in the resources under its management to help the organizations collaborate with other organizations. ERP II solutions are typically used to enable collaborative initiatives such as supply chain management (SCM), customer relationship management (CRM), and business intelligence (BI) among business partner organizations through the use of various e-business technologies (Møller, 2005; Ruhi, 2016). Organization Gartner Group (Ganly et al., 2013) in year 2013 introduced the term "postmodern ERP" (some call it also eXtended ERP – xERP). According to Gartner's definition of the postmodern ERP strategy, legacy, monolithic and highly customized ERP suites, in which all parts are heavily dependable on each other, should sooner or later be replaced by a mixture of both cloud-based and on premise applications, which are more loosely coupled and can be easily exchanged if needed.

Early ERP providers focused on large enterprises, smaller enterprises increasingly use ERP systems in last few years. The worldwide ERP market grew from 3.8% from 24.4B USD in 2012 to 25.4B USD in 2013. SAP is in market leadership position, follow by Oracle, Sage, Infor and Microsoft (Pang et al., 2013). ERP will remain basic software in the organisations.

3 Literature review

Technology Acceptance Model

Several theoretical models have been used to investigate the determinants of acceptance and the use of new information technology (IT), such as the theory of reasoned action (TRA; Fishbein and Ajzen, 1975), the theory of planned behaviour (TPB; Ajzen, 1991), the theory of the technology acceptance model (TAM; Davis et al., 1989), innovation diffusion theory (IDT; Rogers, 2003), stage model (SM; Poon & Swatman, 1999), technology-environment-organization (T-O-E; Tornatzky & Fleisher, 1990); and resource-based view (Caldeira & Ward, 2003). Compared to competing models, TAM is believed to be more parsimonious, predicative, and robust (Venkatesh and Davis, 2000; Lu et al., 2003; Liu and Ma, 2006), and so among the theoretical models is most widely used by IS/IT researchers (Davis, 1989; Davis et al., 1989; Amoako-Gyampah and Salam, 2004; Lee et al., 2010; Costa et al., 2016) and therefore numerous IS researchers apply this method to ERP research. TAM posits that two beliefs – perceived usefulness (PU) and perceived ease of use (PEOU) – are of primary relevance for computer acceptance behaviour (Davis et al., 1989). PU is defined as “the degree to which a person believes that using a particular system would enhance his or her job performance” (Davis 1989, p. 320). PEOU in contrast, refers to “the degree to which a person believes that using a particular system would be free of effort” (Davis 1989, p. 320). The two central hypotheses in TAM state that PU and PEOU positively influence an individual’s attitude towards using a new technology (AT), which in turn influences his or her behavioural intention (BI) to use it. Finally, intention is positively related to the actual use (U). TAM also predicts that PEOU influences PU, as Davis et al., (1989, p. 987) put it, “effort saved due to the improved perceived ease of use may be redeployed, enabling a person to accomplish more work for the same effort”. The key purpose of TAM is to provide a basis for tracing the impact of external factors on internal beliefs, attitudes, and intentions (Davis et al., 1989). Original TAM is presented in Figure 1 in grey rectangle. The original TAM is well established and tested and furthermore, a variety of extensions regarding external factors by examining the antecedents of PU and PEOU has been developed such as TAM 2 (Venkatesh and Davis, 2000), UTAUT (Venkatesh et al., 2003) and TAM 3 (Venkatesh and Bala, 2008).

ERP solutions

Even though TAM can be applied to a variety of technologies, the constructs of TAM need to be extended by customizing factors for specific information systems (Calisir et al., 2009). Few studies, have investigated ERP user acceptance and usage utilizing TAM, and most of them investigate a small number of external factors (for latest researches see Calisir et al., 2009; Shih & Huang, 2009; Sun et al., 2009; Youngberg et al., 2009; Lee et al., 2010; Sternad et al. 2011; Sternad & Bobek, 2013, 2014; Mayeh et al., 2016; Costa et al., 2016).

See table 1.

Table 1: ERP Literature on TAM. Source: Updated from Sternad et al. (2011).

Author(s)	Focus
Amoako-Gyampah & Salam, 2004.	They tested the impact of four cognitive constructors (PU, PEOU, perceived compatibility, and perceived fit) on AT and symbolic adoption.
Nah et al., 2004.	Their study evaluated the impact of one belief construct (shared beliefs in the benefits of a technology) and two technology success factors (training and communications) on PU and PEOU in one global organisation.
Shivers-Blackwell & Charles, 2006.	They researched student readiness for change (through gender, computer self-efficacy, and perceived benefits of ERP) on BI regarding ERP implementation.
Bradley & Lee, 2007.	They investigated via case studies the relationship between training satisfaction and the PEOU, PU, effectiveness, and efficiency in implementing an ERP solution at a mid-sized university.
Hsieh & Wang, 2007.	They researched the impact of PU and PEOU on extended use.
Bueno & Salmeron, 2008.	They developed a research model based on TAM for testing the influence of the critical success factors (top management support, communication, cooperation, training, and technological complexity) on ERP implementation.
Kwahk & Lee, 2008.	They examined the formation of readiness for change (enhanced by two factors: organisational commitment and perceived personal competence) and its effect on the perceived technological value of an ERP solution leading to its use.
Uzoka et al., 2008.	They extended TAM to research the selection of ERP by organisations using factors: impact of system quality, information quality, service quality, and support quality as key determinants of cognitive response as well as which ERP solution to purchase/use.
Calisir et al., 2009.	They examined factors (subjective norms, compatibility, gender, experience, and education level) that affect users' BI to use an ERP solution based on potential ERP users at one manufacturing organisation.
Scott & Walczak, 2009.	They investigated students cognitive engagement, prior experience, computer anxiety, and organizational support as determinants of computer self-efficacy in the use of a multimedia ERP system's training tool
Shih & Huang, 2009.	Their study attempted to explain BI and AU through incorporated additional behavioural constructs: top management support, computer self-efficacy, and computer anxiety.

Sun et al., 2009.	They extended IT usage models to include the role of ERP's perceived work compatibility in users' ERP usage intention, usage, and performance in work settings.
Youngberg et al., 2009.	They researched impact of PEOU, result demonstrability, and subjective norm on PU and impact of it on usage behaviour.
Lee et al., 2010.	They examined factor organisational support (formal and informal) on original TAM factors.
Sternad et al., 2011.	They expose and research external factors which have influence on ERP users in operation phase and investigate the impact of those factors on ERP solution use in company.
Sternad Zabukovšek & Bobek, 2013.	They extent original TAM with groups of external factors (personal characteristics and information literacy, system and technology characteristics, and organizational-process characteristics) and work compatibility and researched influence the ERP adoption among 44 companies in maturity phase.
Sternad Zabukovšek & Bobek, 2014.	They research and compare the importance of external factors for two global solutions - SAP and Microsoft Dynamics NAV – regarding user acceptance.
Costa et al., 2016.	They extended original TAM with factors top management support, training, and the system quality and research their impact on adoption and user satisfaction.
Mayeh et al., 2016,	They examined the effects of factors absorptive capacity (for understanding, for assimilating and for applying), communication and trust (system and vendor) through original TAM and intention to use ERP solution.

Just two from above table (Shivers-Blackwell and Charles, 2006; Scott and Walczak, 2009) researched students ERP acceptance through TAM model. But both authors used small numbers of external factors. Shivers-Blackwell and Charles (2006) also researched student readiness to use ERP technology through model TAM, but they researched ERP acceptance after students read an online newsletter provided by the ERP communication, education, and training team entitled "What is ERP". Participants were then solicited by their professors to complete the survey. So, they did not have practical experience with use of ERP solution. Their research shows that gender and perceived ERP benefits are related to students' readiness for change, and readiness for change is a significant predictor of students' attitude toward usage of the ERP system. Scott and Walczak (2009) examined cognitive engagement, prior experience, computer anxiety, and organizational support as determinants of computer self-efficacy in the use of a multimedia ERP system's training tool. They also examined the impact of computer self-efficacy on its acceptance. The sample consisted of 239 students taking an ERP course elective in the information systems undergraduate and graduate programs.

4 Student ERP acceptance

To examine ERP users' use of ERP systems, we need to extend the TAM. Synthesizing prior researches on TAM and researches on ERP systems, a conceptual model that represents the cumulative body of knowledge accumulated over the years from TAM and ERP research has been developed (Figure 1).

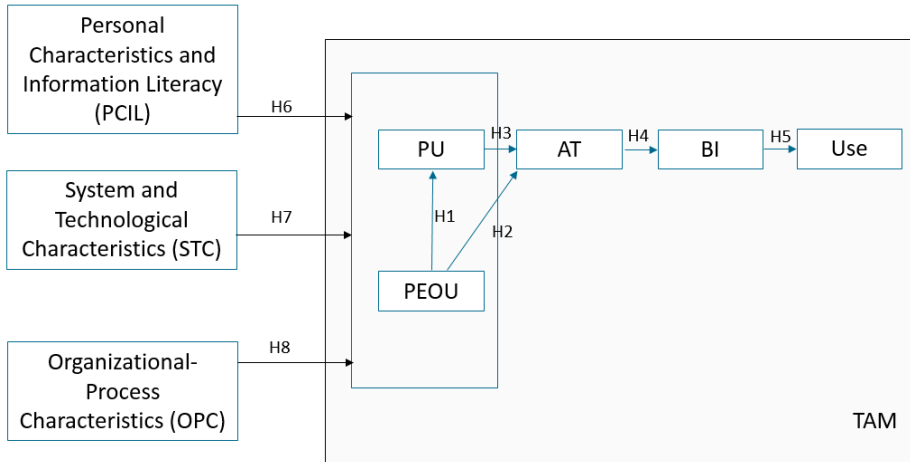


Figure 1: Conceptual Model

Our goal is to research student acceptance of ERP solutions while they are involved in ERP topics after short interaction with the systems (after 12 hours) and which external factors have impact on it. We are preparing conceptual model which will include factors of original TAM (perceived ease of use – PEOU, perceived usefulness – PU, attitude toward using ERP system – AT, behaviour intention – BI, actual use - Use). Therefore, we use hypothesizes from original TAM (Davis, 1989; Davis et al., 1989):

H1: Perceived ERP ease of use (PEOU) has positive and direct effect on perceived ERP usefulness (PU).

H2: Perceived ERP ease of use (PEOU) has positive and direct effect on attitude toward ERP system (AT).

H3: Perceived ERP usefulness (PU) has positive and direct effect on attitude toward ERP system (AT).

H4: Attitude toward ERP system (AT) has positive and direct effect on behaviour intention (BI).

H5: Behaviour intention (BI) has positive and direct effect on actual use (Use).

Even though TAM can be applied to a variety of technologies, the constructs of TAM need to be extended by customizing factors for specific information systems. One problem with TAM research is that most researchers investigate small number of external factors. In case of ERP acceptance, several external factors may influence user acceptance. Thus, the conceptualisation of multiple, higher-order factors (in our case second-order factors) must be investigated to understand user behaviour.

We expose in prior researches that external factors could be distributed among three groups of factors which are personal characteristics and information literacy (PCIL), system and technological characteristics (STC), and organizational-process characteristics (OPC) (see Sternad et al., 2011, Sternad and Bobek, 2013; Sternad and Bobek, 2014). In these three groups, we are trying to capture many external factors which influence ERP user acceptance in operational phase. Since we research student acceptance of ERP solution we must adjust and add some other external factors. Personal characteristics and information literacy (PCIL) includes personality characteristics that can influence individuals' perceptions of ERP system acceptance and usage. Because goal of our research is to research student acceptance of ERP solutions we expose those factors which could have impact of their acceptance of course lectures and exercises regarding ERP solution. We expose several external factors in group PCIL which are: personal innovativeness toward IT (Yi et al., 2006; Thompson et al., 2006), computer anxiety (Venkatesh, 1998; Venkatesh et al., 2003), computer self-efficiency (Venkatesh and Davis, 2000; Venkatesh et al., 2003; Shih and Huang, 2009) and individual benefits (Hsu et al., 2015). In contrast to most IT implementation research, the fact that ERP implementation research is focused on one technology has enabled the effect of specific technological characteristics to be examined. Surveying different research following external factors has been exposed in group of STC: system performance (Venkatesh et al., 2003; Kositanurit et al., 2006), user manuals (help) (Kelley, 2001; Kositanurit et al., 2006), quality of ERP system (Costa et al., 2016) and quality of information in ERP system (Hsu et al., 2015). Organizational-process characteristics (OPC) capture various social processes, mechanisms, and support organizations that guide individuals to facilitate the use of an ERP system. OPC includes social influence (Venkatesh, 1998; Venkatesh et al., 2003) and training and education on ERP system (Amonko-Gyampah and Salam, 2004; Bueno and Salmeron, 2008; Bobek and Sternad, 2011). Therefore, it is hypothesized:

H6: A group of external factors influence use of the ERP system through the conceptual factor personal characteristics and information literacy (PCIL).

H7: A group of external factors influence use of the ERP system through the conceptual factor system and technological characteristics (STC).

H8: A group of external factors influence use of the ERP system through the conceptual factor organizational-process characteristics (OPC).

5 Research design and procedure

The components of the proposed model are PU, PEOU, AT, BI and U, where PU and PEOU influenced by various external factors. The external factors are distributed among three second-order constructs which are: personal characteristics and information literacy (PCIL), system and technological characteristics (STC), and organizational process characteristics (OPC). Second-order factors are composed by specifying a latent variable which represents all the manifest variables of the underlying lower-order factors. PCIL includes: personal innovativeness toward IT, computer anxiety, computer self-efficiency and individual benefits. STC is composed of: system performance, user manuals (help), quality of ERP system and quality of information in ERP system. OPC includes: social influence and training and education on ERP system. Our conceptual model includes 15 first-order factors and 3 second-order factors.

We already did researches regarding user acceptance of ERP solutions (different phases, various ERP solutions, countries etc.) in organizations. The instrument was pilot tested with a group of 30 ERP users in one organization. Based on the results of the pilot testing, revisions and additions were made to the instrument. All the items of factors were measured on a 7-point Likert scale, ranging from ‘strongly disagree’ to ‘strongly agree’; the scale was adopted from relevant prior research and adapted to relate to the context of student’s ERP usage. Demographic information was collected as well.

The survey was conducted among group of 121 students. The group included students who have course E-business (all students of professional programme in the 3th year). They do not have any knowledge regarding ERP solutions at the beginning of the course. Course includes 15 teaching hours lectures from ERP topics with focus on the business processes in Microsoft Dynamics NAV and 15 teaching hours exercises in computer lab where they have hands on training of some business processes in Microsoft Dynamics NAV (introduction, purchasing process, manufacturing process and sales process). We are using version Microsoft Dynamics NAV 2016 (NAV).

The survey was carried out after short interaction with NAV solution (after 1st month; 12 hours). We distributed paper version of questionnaire after 12 hours contact with ERP solution in the beginning of lecture and gave them half an hour to solve it. Students had 8 hour of lectures about ERP solutions, Microsoft Dynamics solutions and Microsoft Dynamics NAV, purchasing process in NAV and production process in NAV and 4 hours of computer lab exercises, where get familiar with navigation in NAV solution, purchasing process in NAV solution till then. 121 questionnaires were properly filled out by respondents and used for the purpose of analysis.

Respondents were 38.8% (47) male and 61.2% (74) female. They have topics regarding Microsoft Dynamics NAV 2016 - 4 hours per week: 2 hours lectures, 2 hours computer lab exercises and 0 individual work (students usually study before exams). The average age of students is 21.66 years.

6 Analysis and results

Demographic data were analysed by SPSS. All other empirical data were analysed PLS technique, using Smart PLS 3.2.1. Partial least squares (PLS) approach can be employed to estimate the parameters of a hierarchical model and also allows the conceptualisation of higher-order factors through the repeated use of manifest variables (Tenenhaus et al., 2005). A higher-order factor can thus be created by specifying a latent variable which represents all the manifest variables of the underlying lower-order factors. We employed a PLS approach because of the relatively small number of samples of valid data and our desire to analyse second-order factors. Data was analysed in two stages involving a PLS technique using Smart PLS 3.2.1 (Ringle et al., 2015).

All measurement scales were examined for their psychometric properties (reliability, convergent validity, and discriminant validity) prior to testing hypotheses (bootstrapping with 500 subsamples). Results of measurement model were satisfactory (results can be obtained by authors). The hypothesis testing results utilize bootstrapping (with 500 subsamples) to test the statistical significance of each path coefficient using t-tests, as recommended by Chin (1998). Results of this analysis are shown in Figure 2.

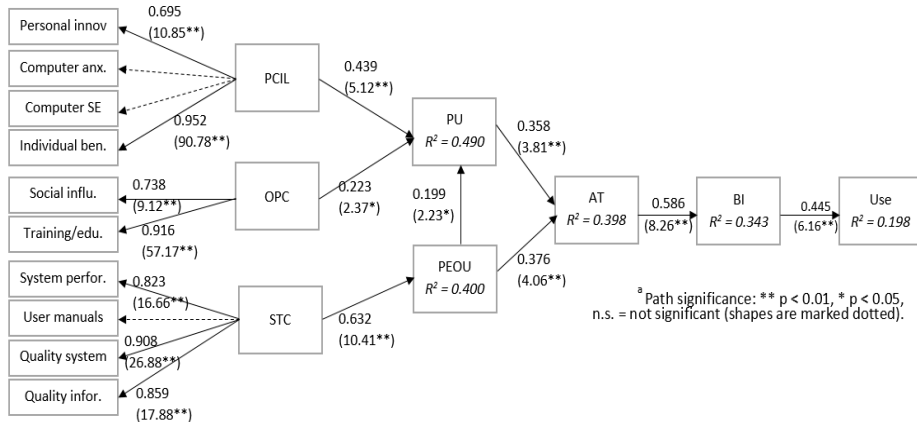


Figure 2: Results of structural model analysis

Our research confirms results of original TAM. Perceived ERP ease of use (PEOU) has weak but significant effect on perceived ERP usefulness (PU) (H1; $b = 0.199$, $p < 0.05$) and strong significant effect on attitude toward using ERP system (AT) (H2; $b = 0.376$; $p < 0.01$). Perceived ERP usefulness (PU) has strong significant effect on attitude toward using ERP system (AT) (H3; $b = 0.358$; $p < 0.01$). Attitude toward using ERP system (AT) strongly influences on behaviour intention (BI) (H4; $b = 0.586$; $p < 0.01$) and behaviour intention (BI) strongly influences on actual use (Use) (H5; $b = 0.445$; $p < 0.01$). Second-order factors (PCIL, OPC and STC) have significant positive effect on perceived usefulness (PU) and on perceived ease of use (PEOU). PCIL has a strong positive effect

on perceived ERP usefulness (PU) ($b = 0.439$, $p < 0.01$). OPC has a weak but significant effect on perceived ERP usefulness (PU) ($b = 0.223$, $p < 0.05$). STC has very strong positive effect on perceived ERP ease of use (PEOU) ($b = 0.632$, $p < 0.01$), and these findings provide empirical support for hypotheses H6, H7, and H8.

7 Discussion

Our results of original TAM model go with results of other researchers who research IT/IS acceptance (Davis, 1989; Davis et al., 1989; Heijden, 2001; etc.). Both, perceived ERP usefulness (PU) and perceived ERP ease of use (PEOU) have strong positive effect on ERP usage, where relationship of perceived ERP ease of use (PEOU) is a little stronger. This is not consistent with Davis (1989), Davis et al. (1989) and Simon and Paper (2007) who expose that perceived usefulness (PU) has stronger positive effect on IT/IS usage as perceived ease of use (PEOU), while perceived ease of use (PEOU) has not so strong or even not statistical effect on IT/IS usage after some time of usage. On the other hand, results of some researches show stronger effect of perceived ease of use (PEOU) on attitude toward using ERP system (AT) than perceived ERP usefulness (PU) on attitude toward using ERP system (AT) (for example see Nah et al., 2004). Because survey was carried out after short period of ERP solution learning it could be reason for that result. Some IT/IS researches show strong positive effect perceived ERP ease of use (PEOU) on perceived ERP usefulness (PU) (Heijden, 2001; Davis, 1989), but this is not consistent with our study, where perceived ERP ease of use (PEOU) has weak positive effect on perceived ERP usefulness (PU). Empirical findings on that relationship in the context of ERP are different, since some researches did not confirm a statistically significant relationship between two (Hwang, 2005; Shivers-Blackwell and Charles, 2006; Shih and Huang, 2009), while other researches confirmed a statistically significant positive relationship (Amonko-Gyampah and Salam, 2004; Hsieh and Wang, 2007; Bueno and Salmeron, 2008; Calisir et al., 2009; Lee et al., 2010). Factor attitude toward using ERP system (AT) is vital in the TAM model and has very strong positive effect on behavioural intention (BI) and through it also indirect strong positive effect on actual use (Use), which is consistent with other researches (Pijpers and Montfort, 2006; Simon and Paper, 2007; Nah et al., 2004).

The aim of this research was to identify external factors which influence student ERP usage after they were involved in ERP topics after short interaction with the systems. Based on the analytical results, we can see that it is possible to observe more external factors through second-order factors. The fact that ERP implementation research is focused on one solution (technology) has enabled the effect of specific technological characteristics to be examined. We have not found any research which has examined the effects of system and technology characteristics (STC) upon the ERP system's user acceptance (except ours, see Sternad et al., 2011; Sternad Zabukovšek and Bobek, 2013, 2014). STC has strong impact on perceived ease of use (PEOU) through external factors system performance, quality of NAV system and quality of information in NAV system. Factor user manuals is not statistically significant – it could be because students did not work alone (individual work) and they did not use user manuals until then.

Second order factor Personal characteristics and information literacy (PCIL) has through personal innovativeness toward IT (software tools and applications) and individual benefits greater impact on perceived usefulness (PU) than second order factor Organizational-process characteristics (OPC) through social influence and training and education on ERP system. This means that for students are more important fact that they see individual benefits using NAV systems and that they like to use any computer tool/applications then social influence and training and education on ERP system.

Furthermore individual benefits (enhance awareness and recall of future job, enhance effectiveness in the job, increases productivity, positive effect on my future career etc.) has stronger effect on perceived usefulness (PU) than personal innovativeness toward using software tools and applications (I like to experiment with new IT, I'm usually the first to try out new IT, I like to experiment with new IT). Factors computer anxiety and computer self-efficiency are not statistically significant – these students are students of higher class (third year at faculty), who had several courses related to IT during the primary and secondary schools and also at the time of the study. Factor training and education of NAV (lectures provide overview on business processes in NAV, materials of lectures/lab exercises are appropriate, based on lectures I understand why I have to be able to use NAV) has stronger effect on perceived usefulness (PU) than social influence (people (teachers, students, professionals) who have influence on students' perception regarding NAV/ERP).

8 Conclusion

The aim of this research was to research which external factors have impact on students' acceptance of ERP within study programme, while they are exposed to ERP solution (in our case Microsoft Dynamics NAV). We want to know how to motivate students to take seriously course E-business where we teach students ERP solution Microsoft Dynamics NAV. We exposed 10 external factors which have impact on student ERP acceptance. This work extended previous researches by incorporating groups of external factors, which have influence on students ERP acceptance. Studying the influence of more external factors on constructs not only contributes to the theory development, but also helps in designing teachers' curriculum.

Our research shows that external factors personal innovativeness toward IT (software tools and applications) and individual benefits (regarding future job) are very important personal factors which have impact on students ERP usage, while computer anxiety and computer self-efficiency are not important. It could be because students did not work alone (individual work) and they did not use user manuals until then. Organisational-process factor training and education of ERP is more important than factor social influence (people (teachers, students, professionals) who have influence on students' perception regarding NAV/ERP) and therefore we suggest to teachers put a lot effort to prepare excellent teaching materials and to try to explained students' ERP topics related content in an easy way. Scott and Walczak (2009) results show the importance of intrinsic and extrinsic motivation of to ERP training, through cognitive engagement (a form of

intrinsic motivation) and organizational support (a form of extrinsic motivation). Understanding of ERP solutions is challenging for students, because they do not have practical experience of how ERP solutions is used in enterprises. Important system-technological factors are system performance, quality of NAV/ERP system and quality of information in NAV/ERP system, while factor user manuals is not important after short interaction with the system.

The implications for researchers and practitioners include an extended version of TAM through second-order factors to improve the explanatory power of ERP usage. The technique (PLS approach) for analysis of model was used. This study has certain limitations which may present the opportunity for further research. Since the respondents were limited to one group of students in Slovenia, this study should be extended to other counties. Further research is needed to explore the importance of presented external factors in different time frames (after introduction of course, at the end of course) as well as include additional external factors. Another limitation is also that research was conducted for one ERP solution –Microsoft Dynamics NAV, because of that the importance of external factors of different ERP solutions also could be explored (SAP, Infor ERP etc.).

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Characterization of Business Model Research: Bibliometric Analysis and the Future Agenda

IVAN ŽUPIČ, MARKO BUDLER & PETER TRKMAN

Abstract The term business model has gained widespread use. Several papers discussing its origins and value have been published recently. However, most of them are more of a descriptive analysis of past research. We provide a more rigorous investigation with the help of bibliometric methods of citation analysis, bibliographic coupling and co-word analysis to examine 308 articles on business models published in the period 2010-2015. Bibliometric methods build maps of science fields based on citation information and are able to quantitatively complement literature reviews. We extracted bibliographical data from the Web of Science database. Our algorithm found four clusters of business model research. We also visualized the top 80 keywords in a heat map which presents clear thematic picture of business model conceptual domain.

Keywords: • bibliometric methods • bibliographic coupling • co-word analysis • business mode l•

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1 Introduction

Hyper-turbulent environment and contemporary issues in incumbent businesses established the need for in-depth observations of companies' business models and their components. Elaborating on the absence of consensus on what a business model is or what it is not (DaSilva & Trkman, 2014), we provide readers the insights from the most important areas within a business model research in the infant stage of business model topic (before 2011) and 6 years after Zott, Amit, and Massa (2011) identified some of the most visible clusters in business model research.

Despite the discrepancies in its definition, business model is usually recognized as a set of resources through which transactions generate value for the company and its customers (Teece, 2010). Business models are necessary for capturing value and constructing organizations' capabilities (Teece, 2010). This vice versa relationship led Zott, Amit, and Massa (2011) to conclusion that business models enable a holistic perspective for observing organizations and their businesses. The assessment of business models, their usage and future trends is helpful, since it can provide us with the insights about the main topics in business and its associated theoretical traditions (Zott, Amit, & Massa, 2011).

Drawing on the on-going research, our paper provides bibliometric methods which can be used to identify the most influential keywords and future trends in field of business models. Since academic attention paid to business models has recently increased substantially (Spieth, Schneckenberg, and Ricart 2014) a bibliometric analysis can provide a coherent map of contemporary business model research and assist both scholars and practitioners in innovating business models, along with recognizing the future trends in that area.

Our aim is to identify the past conversations (Huff, 1999) within business model literature and future avenues. Several excellent reviews of the field (Zott, Amit, & Massa 2011; Spieth, Schneckenberg, & Ricart, 2014) relied on the method of structured literature review to establish the state of the art in the field. Our contribution is to complement these reviews with bibliometric methods that use quantitative bibliographical data (Zupic & Čater, 2015). In this way we can tap into the knowledge created by scholars in the field who expressed their opinion by citing (or not!) specific articles and books. Such an investigation also forms an excellent basis to speculate on whether business model will survive as a term within strategic management and information systems literature as a distinct term to e.g. competitive advantage, strategy or digital transformation.

2 Literature review

Every organization employs a business model that encompasses how value is created, delivered and captured (Teece, 2010). An ample amount of research revealed that the consensus on what a utilization, development and structure of a business model has not been reached yet (Zott, Amit, & Massa, 2011). That is why business model has been

applied to different environments and utilized within a different context (Zott, Amit, & Massa, 2011). Besides, phenomena such as the emergence of e-businesses and surge of technology innovations have influenced the development of business models.

Business model is quite difficult to be depicted without a broader understanding of the environment in which organization operates. Despite that, some authors made an attempt to introduce business model through text and graphics (Casadesus-Masanell & Ricart, 2011; Ross, Vitale, & Weill, 2002) in order to provide managers with a unique template for designing a winning business model. In spite of not having a universally applicable ‘template’, business model does depict “the content, structure, and stewardship of transactions that enable value creation in future business opportunities” (Zott & Amit, 2008). Teece (2010) adds data and other evidence into business model concept, since these two seem to support the value proposition for end-users. Finally, a line between strategy and business model was given by Casadesus-Masanell and Ricart (2011), who identified a business model as a reflection of a firm’s strategy. Additionally, business model not only resonates company’s strategy but also links technological innovation to strategy (Chesbrough & Rosenbloom, 2002). Innovation and technology are two facets of business models development, whereas only a scant amount of scholars have more or less successfully conceptualized business models’ elements and relationships (Osterwalder, Pigneur, & Tucci, 2005; Baden-Fuller & Haefliger, 2013).

According to Zott and colleagues an adequate business model is the one with value network encompassing both value creation and value capture, meaning to include all stakeholders and distribution channels along the entire supply chain of a certain organization. A company should not focus only on improving business model elements but to develop them in such a way that it will be able to continually change its existing or add a new business model as a response to unexpected changes (Trkman, Budler, & Groznik, 2015). Unfortunately, managers usually respond by optimizing only each of the element of the current business model (DaSilva, Trkman, DeSouza, & Lindič, 2013). This is insufficient, because the development of a new business model entails a paradigm shift, which requires an in-depth analysis of customers, competitors and partners (Teece, 2010). More importantly, the emphasis should be on articulation of business model and an evaluation “against the current state of the business ecosystem, and against how it might evolve” (Teece, 2010). The allure of business models is that they are based on observation and theorizing (Baden-Fuller & Morgan 2010), making them a perfect template for running companies’ businesses.

Business model development is a long-term process (Dmitriev, Simmons, Truong, Palmer, & Schneckenberg, 2014) that can ‘shake’ the markets or vice versa as seen when the emergence of information-communication technologies (ICT) stroke the concept of a business model (DaSilva & Trkman, 2014). In fact, authors have shown how difficult it is to create a winning business model, especially in the era of disrupting ICT innovations (DaSilva et al., 2013). In light of this, a great variety of business models became ‘ICT-enabled’, since, after all, ICT provides organization with new channels for interacting

with customers (Wu, Guo, & Shi, 2013). Besides, there is yet a case to be made for sustainable business models (Stubbs & Cocklin, 2008), since sustainable business models are the ones interacting with and augmenting company's resources, partnerships and relations with customers (Matos & Silvestre, 2013).

In regard to developing business models, we have seen an ample amount of companies (Singapore Airlines, Nestle, SHM etc.) possessing multiple business models in order to cope with different niches and preferences from end-users. Real-life business environment establish a need for using multiple business models (Martínez-Olvera, 2009); however, doing this might be a double-edged sword (Markides & Charitou, 2004). A great challenge to be addressed when companies try to utilize two different business models is that two (or more) business models will sooner or later interfere, causing conflicts. Two solutions were advised (Markides & Charitou, 2004); first, organization could physically separate both of the business models to avoid their interactions or, second, business models could be merged in order to exploit synergies.

There has been a common misunderstanding on how to distinguish a strategy from a business models. Not only due to similarities between these two but also because of the strategic function embedded in business models (Osterwalder, Pigneur, & Tucci, 2005). DaSilva and Trkman (2014) understand a strategy as a key determinant in the development of capabilities that enable future business models within an organization. Another distinction between strategy and a business model has been provided by (Casadesus-Masanell & Ricart, 2011); authors claim that "every organization has some business model", whereas "not every organization has a strategy". As business models are seen as a source of competitive advantage, the interplay between the strategy and the business models gained its importance (Zott, Amit, & Massa, 2011).

Finally, there is a business model innovation defined as 'the discovery of a fundamentally different business model in an existing business' (Markides, 2006), or as a quest for finding a new template on which an organization could create and capture value not only for its customers but also for its stakeholders (Spieth, Schneckenberg, & Ricart, 2014). Business model innovation can lead to organization achieving competitive advantage if the model is enough revolutionary and difficult for imitation by competitors (Teece, 2010). Incumbent businesses tend to elicit value from innovative ideas and disruptive technologies throughout their business models (Zott, Amit, & Massa, 2011). Interestingly, the process can work vice versa, since business models are often shaped by modern technology and innovations (Zott, Amit, & Massa, 2011). Business model or the development of business model can be seen as a stage between an idea growing from invention towards innovation (Dmitriev et al. 2014), however, with an emphasis on business model ensuring that not only technology is engraved but also that the innovation is economically sound (Chesbrough & Rosenbloom, 2002).

3 Methodology

We mapped the business models literature with bibliometric methods (Zupič & Čater, 2015). These methods use the citation information in bibliographical databases to extract meaningful information about the structure of scientific fields. The quantitative information gathered from bibliometric analysis can be a useful complement to the traditional structured literature review. Specifically, we used the methods of citation analysis, bibliographic coupling (Kessler, 1963) and co-word analysis (Callon, Courtial, Turner, & Bauin, 1983).

Citation analysis measures the influence of specific documents or journals by measuring their citation frequencies. If certain article or journal is more cited it is assumed it had greater influence on the literature than its less cited counterparts. Bibliographic coupling uses the similarity of reference lists to establish connections among scientific publications. For example, if ten publications appear in both reference lists of two scientific papers, this means that these two papers are connected with coupling strength of ten. The stronger the coupling strength, the stronger the connecting link. When this information is gathered for all relevant publications in the scientific field of interest, clustering methods can be applied to delineate the structure of the field and identify the substreams of research. Co-word analysis, on the other hand, connects the word terms by their appearance in the same title or abstract. If two terms appear together multiple times this means that the connection link between them is stronger. Again, putting together this information for the whole scientific field gives us a clear thematic picture of the field's conversations.

We searched Thomson Reuters Web of Science (WoS) for “business model” in the topic (i.e. title, abstract or keywords) of published articles in the time period 2010-2015. We selected this period because we wanted to analyse the current conversations and not the past literature. The search returned 1533 entries, which we further filtered for Business, Management and Economics categories. Of the remaining 598 articles we selected only document types of ‘article’, ‘editorial material’ and ‘review’ which left us with 580 entries. The abstracts of all 580 documents were read and rated (Yes-include/Not-include) by two authors. Criterion for inclusion in the sample was that business model was one of central themes of investigation in the research study. Articles that only passingly mentioned business model concept were excluded from the sample. After rating the articles independently the interrater agreement was 86.4%. The differences on the remaining 79 articles were reconciled by re-reading the abstracts by both raters together and reaching decision whether to include the contentious article. After this process 308 articles were left.

4 Findings

We have conducted three types of analyses of business model literature. First, the citation analysis shows the most important publications outlets for contemporary business model research, which journals consist the knowledge base of business model research and which documents are the most cited within the literature. Second, the bibliographic coupling followed by the application of network community finding algorithm provides the structure of contemporary business model research that is based on the quantitative citation data. Finally, the co-word analysis of most important keywords in abstracts and titles shows the topical domain of business model research.

4.1 Citation analysis

Table 1 summarizes which journals published the most articles in the 2010-2015 period (left part of the table) and which journals are most cited (right part of the table). Profiles of journals that publish business model research reflect the main focuses of business model literature. First, there are strategy journals (Long Range Planning, Strategic Entrepreneurship Journal, Technology Analysis & Strategic Management and Strategic Organization) meaning that business model construct is of main interest to strategy scholars. Second, there are two premier journals oriented to practitioners (Harvard Business Review and California Management Review). This reflects that business models have value for managers. Third and most numerous group are innovation and technology management journals (Research-Technology Management, R&D Management, International Journal of Technology Management, Technological Forecasting and Social Change). These reflect that innovative business models are considered as a primary vehicle for commercializing technological innovations. Last two groups of journals are oriented to marketing (Industrial Marketing Management and Electronic Markets) and general management (European Management Journal, Management Decision and Chinese Management Studies). The absence of top tier management journals (like Academy of Management Review or Academy of Management Journal) in this list is notable. It looks like that business model research is mainly published in specialized outlets and management journals below top tier.

The list of 25 most cited documents in Table 1 is comprised almost exclusively of business model articles. The knowledge base of contemporary business model research is therefore dominated by previous business model studies with very weak outside influences. The most cited paper is Teece (2010) with 102 citations which means that almost a third of core business model articles published between 2010-2015 cited that paper. There are several authors that have multiple entries on the top 25 list: Christoph Zott and Raphael Amit have five co-authored articles on the list while Henry Chesbrough has four articles or books. The only document that is not part of business model research stream is Eisenhardt's (1989) paper on building theories from case study research. This reflects the fact that the majority of the empirical articles on business models are based on qualitative case studies.

Table 1: Top 25 most cited documents in business model literature

No.	Document
102	Teece DJ, 2010, V43, P172, Long Range Plann
99	Amit R, 2001, V22, P493, Strategic Manage J
91	Chesbrough H, 2002, V11, P529, Ind Corp Change
72	Morris M, 2005, V58, P726, J Bus Res
70	Zott C, 2011, V37, P1019, J Manage
70	Zott C, 2008, V29, P1, Strateg Manage J
70	Chesbrough H, 2010, V43, P354, Long Range Plann
66	Magretta J, 2002, V80, P86, Harvard Bus Rev
64	Casadesus-Masanell R, 2010, V43, P195, Long Range Plann
63	Zott C, 2010, V43, P216, Long Range Plann
58	Zott C, 2007, V18, P181, Organ Sci
47	Demil B, 2010, V43, P227, Long Range Plann
46	Eisenhardt KM, 1989, V14, P532, Acad Manage Rev
44	Osterwalder A., 2010, Business Model Gener
42	Mcgrath RG, 2010, V43, P247, Long Range Plann
38	Shafer S. M., 2005, V48, P199, Bus Horizons
37	Johnson MW, 2008, V86, P50, Harvard Bus Rev
36	Baden-Fuller C, 2010, V43, P156, Long Range Plann
30	Sosna M, 2010, V43, P383, Long Range Plann
28	Osterwalder A., 2005, V16, P1, Communications Ass I
27	Chesbrough H. W, 2006, Open Business Models
27	Timmers P., 1998, V8, P3, Electron Mark
27	George G, 2011, V35, P83, Entrep Theory Pract
25	Hedman J, 2003, V12, P49, Eur J Inform Syst
25	Chesbrough H., 2007, V35, P12, Strategy Leadership

4.2 Bibliographic coupling

We narrowed down the selection to articles that were cited at least two times per year. Before implementing bibliographic coupling we further excluded 14 articles with coupling strength less than 20 (i.e. which share less than 20 common pairs of references with all other articles; the data about these articles is insufficient for coupling and we can assume these articles are not part of the core document set). After these steps, 62 articles

were left in the sample. We have visualized four clusters of business model research in Figure 1.

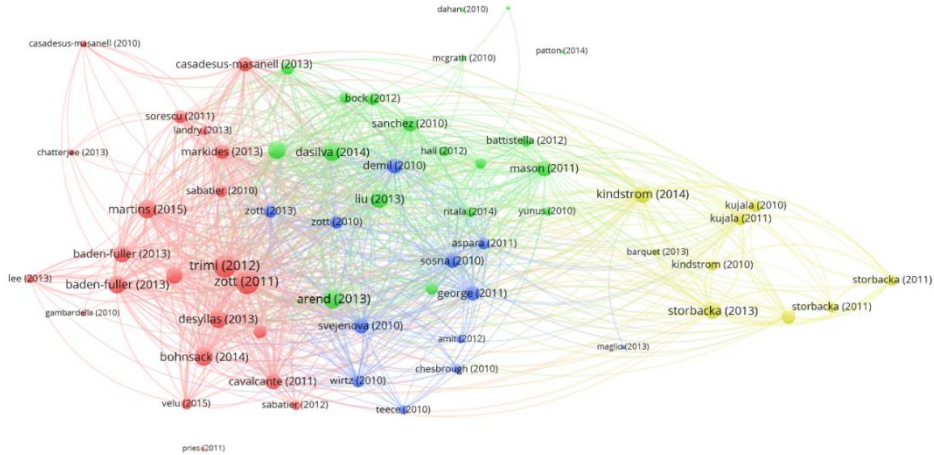


Figure 1: The four clusters of business model research based on bibliographic coupling

Cluster 1 (red) is the largest with 22 articles. The dominant theme is the interface between technological innovation and business model of the firm. Main topics in this cluster include the role of technological innovation (Baden-Fuller & Haefliger, 2013; Bohnsack, Pinkse, & Kolk, 2014) and technological discontinuities (Sabatier, Craig-Kennard, & Mangematin, 2012), the cognitive aspect of business model concept (Baden-Fuller & Mangematin, 2013; Martins, Rindova, & Greenbaum, 2015) but also reviews of the field (Zott, Amit, & Massa, 2012).

Cluster 2 (green) contains 19 articles. The vast majority of authors in this cluster are focusing on understanding the idea (concept) of a business model by identifying and explaining its meaning (DaSilva & Trkman, 2014). Authors execute ‘sensemaking’ out of business models and try to make them context-dependent with regard to organizational strategy. A major question in this cluster is the distinction between business model and strategy (Casadesus-Masanell & Ricart, 2010). Additionally, the authors examine what is the role of business model when constituting strategies. In light of ‘sensemaking’, some of the authors have pursued their research to elucidating changing meaning of the business models, how the business model notion is changed due to the environment, and how to distinguish between various business models.

Cluster 3 (blue) has 12 articles. It is predominantly strategy-based and the core of this cluster is represented by several publications of the 2010 Long Range Planning special issue on business models (e.g., Wirtz, Schilke, & Ullrich, 2010; Teece, 2010; Zott & Amit, 2010).

The area on the right shows papers emphasizing the importance of business model innovation, its meaning in change management and its role, especially in terms of enhancing organizations' performance, as emphasized by Casadesus-Masanell and Ricart (2011). Furthermore, central cluster of keywords confirmed business model as the most important 'tool' for delivering value to customers; however, the value cannot be elicited from business model if organizations lack cutting-edge technology. In fact, not only technology but also various elements and capabilities play an important role when it comes to refining a business model (Trkman et al., 2015). Another two (centre-left corner and top-left corner) clusters have pointed out that business model is redeemed as a system or a concept encircled around its focal element–product.

5 Discussion

In preliminary research we examined the 308 articles on business models published in the period 2010-2015. In further research we will also examine articles before 2010 and articles published in 2016. Business model topic has covered the emergence of e-businesses and surge of technology innovations that influenced the vast majority of organizations. It can be discussed how much a business model is context-dependent, nevertheless, the future research should give us more information about business models' elements and the interplay between them. Further, by examining articles published in different periods thoroughly, we tend to investigate how the business model research has changed over time and, second, contemplate which future avenues are most likely to be addressed.

The results of the citation analysis of the papers and the four identified clusters by bibliographic coupling jointly paint a coherent picture of the business model research. The disciplinary landscape spans from technological innovation through strategy to marketing. This is reflected in the journals that publish business model research, which also include practitioner outlets like Harvard Business Review. This makes the business model construct uniquely positioned to integrate the supply- and demand-side approaches to strategy (Priem, Li, & Carr, 2012).

6 Conclusion

We used bibliometric methods to examine state of the art of business model research. We identified the most influential documents in contemporary literature, divided the literature into four clusters and visualized its topical structure. Our analysis provides a useful tool for both veteran and new researchers who want to move the field forward.

6.1 Limitations

Bibliometric methods have several well-known limitations. First, it is not possible to determine based on solely citation data why certain document was cited. It could be because the citing author(s) thought the cited reference was important foundation for their

work, but it could be also to refute the claims in cited document or ritually cited because certain citations (usually of old, important and widely cited publications) are expected in the specific scientific fields. Second, our analysis encompasses the most cited works and most used keywords. It is possible that some smaller research substreams were missed even though they could comprise an important but less cited niche. Finally, we have deliberately taken into account only categories "business", "economics", and "management" as we wanted to thoroughly examine the articles published in these mainstream areas. We tend to expand that in further research.

6.2 Further research

First, researchers could pursue the question why the 'conversations' of business models are usually happening only within a certain 'bundle' (Zott, Amit, & Massa, 2011) and what would be the implications of an interplay between these various sub-areas. Second, researchers could initiate follow-up studies on co-word analysis, evaluating whether a synergy between these sub-areas enabled the proliferation of incumbent business models (e.g. sustainable business models). Finally, taking into consideration the results of our inquiry from the journals could lead researchers to a better understanding of the fields and industries interfering with the continuous development of business models.

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Information Management in Supply Chain Partnering: Improving Maintenance Processes in Dutch Housing Associations

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Abstract Maintenance processes of Dutch housing associations are often still organized in a traditional manner. Contracts are based on lowest price instead of ‘best quality for lowest price’ considering users’ demands. Dutch housing associations acknowledge the need to improve their maintenance processes in order to lower maintenance cost, but are not sure how. In this research, this problem is addressed by investigating different supply chain partnering principles and the role of information management. The main question is “How can the organisation of maintenance processes of Dutch housing associations, in different supply chain partnering principles and the related information management, be improved?” The answer is sought through case study research.

Keywords: • supply chain partnering • information management • building information model (BIM) • maintenance • process innovation •

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1 Introduction

The Netherlands has a strong tradition of social housing for lower income groups. Within this tradition, housing associations are a major player (Boelhouwer et al., 2014) something which dates back to the 1901 Housing Act. In the beginning, social housing was operated from the pillarization, the politico-denominational segregation. After World War II, the Dutch government managed and prescribed how, what and where to build. From the mid-1990s, the government withdrew itself and stimulated self-reliance (Van Gijssel, Gärtner, Bos, Van Dellen, & Minke, 2014). Today, the social housing system is failing, the decreasing support from society is a crucial threat to the future of the system (Boelhouwer et al., 2014). Therefore, innovation of the system, among other things by regaining commitment between the housing associations and their target population, is vital (Boelhouwer et al., 2014). A focus on core activities is, together with the first benchmark by Aedes in 2015 (the national organisation promoting the interests of social housing organisations in the Netherlands), the first step in the right direction.

With rental incomes that are just sufficient to cover the expenses for management and maintenance, more efficient cooperation with maintenance companies can lead to more efficient maintenance processes and lower maintenance costs (Gruis, 2011). It is believed by both scholars and practitioners that more efficient cooperation can be achieved through supply chain partnering and the effective use of information systems. Especially for housing associations, where the organisation of maintenance occurs in a complex environment. The very diverse property portfolio of housing associations is one of the complexing aspects. The portfolio's consists of recently completed new built houses, post-war dwellings and houses completed in the intervening period. Furthermore, they lack unity regarding (i) construction quality, (ii) compliance with present living requirements, (iii) method of recording the construction and installation engineering information, and (iv) accessibility to and completeness of this information (Jak, 2016; Mans, 2016).

Supply chain partnering (SCP) has become a prominent phenomenon among academics and professionals working in the construction sector (Briscoe & Dainty, 2005; Eriksson, 2015; Gruis, 2011; Segerstedt et al., 2010; Tennant & Fernie, 2014; Venselaar, Gruis, & Verhoeven, 2015; Vrijhoef & Ridder, 2007). Several benefits are ascribed to better coordinated cooperation between supply chain partners, including cost reduction, increase of quality, shorter execution times, and more opportunities for innovation and learning (Eriksson, 2015; Gruis, 2011; Segerstedt et al., 2010; Tennant & Fernie, 2014; Vrijhoef & Ridder, 2007). And although information management is a prerequisite for successful implementation of SCP, there is little attention for the relation between the implementation of SCP and information management. Furthermore, most research on information management in construction focuses on building information modelling (BIM) for new construction (A. Adriaanse, Voordijk, & Dewulf, 2010; Almarshad & Motawa, 2012; Azhar, 2011; Fox & Hietanen, 2007; Love, Matthews, Simpson, Hill, & Olatunji, 2014; Miettinen & Paavola, 2014; Motawa & Almarshad, 2013) while benefits

of BIM could also apply to maintenance. BIM use facilitates the integration of stakeholders thereby reducing fragmentation, improves knowledge management and communication, cooperation, decision-making, and performance of maintenance, and reduces maintenance costs (A. Adriaanse et al., 2010; Almarshad & Motawa, 2012; Azhar, 2011; Deshpande, Azhar, & Amireddy, 2014; Fox & Hietanen, 2007; Love, Simpson, Hill, & Standing, 2013; Van der Vlist, Arno J, Vrolijk, & Dewulf, 2014). However, to fully benefit from BIM coordination of stakeholders and stakeholders' actions is required (Van der Vlist, Arno J et al., 2014). Research on SCP also focuses mostly on new construction, which is surprising since new construction is still mostly about one-time projects while maintenance is an ongoing series of activities. It is the latter that generates opportunities for a more structural cooperation between supply chain partners and also a more structural coordination of activities, resources, and benefits and risks. This research addresses these opportunities and identifies the coordination mechanisms that help improve information management as well as the implementation of SCP.

This research proposal has the following structure, hereafter the problem definition and formulated research question are discussed. Subsequently section three describes the research methodology while section four elaborates on the expected results. Future development of this research is discussed in section five.

2 Problem definition

Opportunities for implementation of SCP are particularly evident in the social housing sector in Northwest Europe, including the Netherlands. In Northwest Europe, the social housing sector is managed by professional property managers, who are capable of building professional partnerships with their contractors. In general, the housing sector is under increased financial pressure, which triggers social landlords to look for more efficient ways of working. According to the Housing Act 2015, Dutch housing associations must focus on building, renting out, and managing and maintaining social housing, and invest in the livability of the neighbourhood. The Housing Act 2015 also allows for commercial activities (such as private sector dwellings in a neighbourhood where houses are being demolished to provide a better mix of lower and higher income groups within the neighbourhood) but only when commercial parties have no interest (Rijksoverheid, 2015). This is executed within a framework of (i) less (governmental) subsidies (Gruis, 2011); (ii) various organisational structures; and (iii) a differentiated property portfolio. In addition, the internal business operations of Dutch housing associations are neither transparent nor efficient. An understanding of the activity-based costs is often imperfect (Boelhouwer et al., 2014), while the necessity to manage costs forces housing associations to develop structures of strategic stock management (Bouw Research, 2013) and a housing stock with sufficient flexibility to anticipate to future developments. In addition, the social rent that is actually paid to the housing association is often lower than the (economic or market) value of the housing services generated by the houses (Gruis, 2002). The internal management of housing associations is often

neither transparent nor functional (Boelhouwer et al., 2014). Potentially, about 80% of all housing associations could improve their processes regarding maintenance (Aedes, 2015). Koolma & Allers (2013) also indicate there is ample room for efficiency gains in the Dutch housing association sector.

In the current organisational structure of maintenance, housing associations still tend to do a lot of maintenance activities themselves. This is costing them a lot of time and money, therefore revenues from rent are just sufficient to cover management expenses (Gruis, 2011). Both scholars and practice recommend that housing associations change their maintenance processes in order to lower the costs involved (Dreimüller, Gruis, & Snoeijs, 2013). This starts with changing the type of contract. Traditionally, parties rely on formal, dyadic contracts that specify each party's financial and other rights, responsibilities, and duties (Lavikka, Smeds, & Jaatinen, 2015). And traditional approaches to maintenance lead to more management time, unnecessary costs, and poor maintenance decision-making (Alshawi, Goulding, Sharp, & Jones, 2012). In addition, in construction projects, the relationship between firms typically last for the duration of the project (Vrijhoef & Ridder, 2007), meaning that learning across and between projects to improve processes hardly ever occurs. Also, construction projects are often criticised because of the performance of contractors, with lower than expected performance in time, costs, quality, and satisfaction levels of clients (Ferrada & Serpell, 2014). Kempton (2009) identified a significant problem with communication and a lack of coordination between the corporate goals of the development, management, and maintenance departments. This is illustrated by three employees of a medium sized Dutch housing association who point out that the new building projects department is an independent entity within the housing association. As a result, one of the key challenges is to have sufficient information available for maintenance work, such as specifications, information on previous maintenance work, a list of specialist professionals to conduct work, etc. (Motawa & Almarshad, 2013). Information is often not available and available information is often not complete or up-to-date nor easily shared among supply chain members. Maintenance processes could be improved through improving coordination and information management processes. This is not provided by a dyadic contract since this type of contract neither provides a shared goal for all project partners, nor specifies the organisational or technological mechanisms to align information and knowledge flows between the project partners (Lavikka et al., 2015). A dyadic contract will more likely lead to fear of opportunism, to an experienced lack of trust in the beginning of the project, which in turn leads to more procedural coordination mechanisms to benefit project outcomes and to reduce project risks (Lavikka et al., 2015). Here, a transition towards integrative supply chain processes appears desirable, because maintenance projects require an approach with a clear and integral set of requirements, where all involved parties cooperate as a well-oiled team (Vijverberg, Van der Krogt, & Keus, 2013). Furthermore, transparency and an increase in efficiency are necessary for the legitimacy of housing associations in society (Aedes, 2015).

The idea of a shift from a fragmented (dyadic) into an integrative way of construction is also a generalised technological promise of building information modelling (BIM) technologies (Miettinen & Paavola, 2014). However, this does not provide a realistic conception of the complexity of the conditions of the implementation of BIM (Miettinen & Paavola, 2014). According to Love et al. (2014) BIM technology in itself has no inherent value; having BIM technology in place will not necessarily provide benefits or create value for a housing association, benefits only arise from its effective use. This asks for coordination of stakeholders' actions (Van der Vlist, Arno J et al., 2014). And learning to cooperate as partners is a social accomplishment, rather than a technical feature (Bresnen, 2010). Partnering must involve the production of new working practices at a local (supply chain) level (Bresnen, 2010). The implementation of BIM could help as it facilitates the integration of the roles of all stakeholders (Azhar, 2011). In 2014 Nobakht stated in *Cobouw*, a daily (online) magazine for construction professionals, that despite the changes and challenges housing associations are facing, structural innovations of the current business models were still omitted. He believes that the barrier for structural innovations lies in the originating small scale building sector, with a traditional way of thinking, a monoculture, and a lack of knowledge regarding strategic business problems (Nobakht, 2014). Construction clients appear to distrust their main contractors who, in turn, distrust their subcontractors and suppliers, and individual players have very little stake in the long-term success of, and therefore no commitment to resulting structure. (Briscoe & Dainty, 2005). The core of the problem is that fragmentation (A. M. Adriaanse, 2014; Behera, Mohanty, & Prakash, 2015) is thought to be of interest to all involved parties although it leads to loss of information, misunderstandings, pointing at each other, sub-optimizations, and additional work (Vijverberg et al., 2013). Although it is believed that supply chain integration must lead to improvement by developing a more stable environment (Vrijhoef & Ridder, 2007), several barriers prevent this integration. The traditional fragmentation leads to resistance towards supply chain integration due to perceived extra costs, partners are unaccustomed to share knowledge across project phases and are unaware of potential benefits (Nam & Tatum, 1992). Successful integration of the construction supply chain is possible. For instance through a multi-party contract which aligns financial interests and builds trust between supply chain partners in the beginning of the project; the contract aligns information and knowledge flow between the project partners by specifying organisational and technological mechanisms (Lavikka et al., 2015). Long term supply chain partnerships (i) make it easier to be vulnerable and communicate freely and thus to establish common norms and good team practices, and (ii) are also positively associated with improved working practices and an increased level of trust (Buvik & Rolfsen, 2015). In high trust groups, coordination is more effective leading to greater efficiency and hence better performance (Dirks, 1999).

Coordination theory is relevant for improving the cooperation in supply chains (Kanda & Deshmukh, 2008; Li & Wang, 2007), especially in combination with the concept of boundary objects (Bresnen, 2010). However, thus far this theory has not been applied to supply chains in the construction industry. Coordination theory has been defined by

Malone and Crowston (1990) as “a body of principles about how activities can be coordinated, that is, how actors can work together harmoniously”. Li and Wang (2007) distinguish two supply chain types, centralised and decentralised. They state that construction supply chains are decentralised supply chains, which are more difficult to coordinate because this requires a scheme to allocate the benefits of coordination throughout the supply chain to maintain the interest and participation of all dependent supply chain partners (Li & Wang, 2007). For this agency theory “offers a unique, realistic, and empirically testable perspective on problems of cooperative effort” (Eisenhardt, 1989). It analyses the relationship that develops in an economic exchange when an individual (the principal) concedes authority to another (the agent) to act in his or her name (Cuevas-Rodríguez, Gomez-Mejia, & Wiseman, 2012). The exercise of coercive and legal power has a strong negative effect on collaborative behaviour, while rewards have a positive effect (Nyaga, Lynch, Marshall, & Ambrose, 2013). The central goal of agency theory is to stop opportunistic behaviour in a situation where parties have different goals and the information supply is incomplete (i.e. the traditional maintenance practice at Dutch housing associations). Coordination theory and agency theory are complementary because where the latter theory presents a partial view of the world that ignores a good bit of the complexity of organisations (Eisenhardt, 1989), the former theory fills this gap by looking at the complexity of cooperation between organisations. Because supply chains are complex with many activities usually spread over multiple organisations and sometimes over lengthy time horizons, it is necessary to overlay a coordinated system (Kanda & Deshmukh, 2008). This coordinated system may include an explicit definition of processes, responsibilities, and structures aligned with overall objectives of the whole supply chain to bring together multiple functions and organisations (Kanda & Deshmukh, 2008). This implies that all these organisations and the people within the organisations have to face, and preferably employ, one of the four dialogical learning mechanisms of boundaries (Akkerman & Bakker, 2011):

- Identification, which is about coming to know what the diverse practices are about in relation to one another;
- Coordination, which is about creating cooperative and routinized exchanges between practices;
- Reflection, which is about expanding one's perspectives on the practices;
- Transformation, which is about collaboration and co-development of (new) practices.

The results of this research are specifically aimed at realising recommendations for improving maintenance processes at Dutch housing associations by improving the collaboration (and coordination) of the supply chain processes. Based on the discussion as described above the results should provide an answer to the following main research question:

How can the organisation of maintenance processes at Dutch housing associations in different supply chain partnering principles and the related information management be improved?

Related sub-questions are:

- What coordination methods are used to align goals and objectives, to align decision-making, to share information, and to align cooperation?
- Do supply chain partners experience the benefits of SCP (improved performance, reduced project costs, reduced project risks)?
- To what extent does BIM support the coordination method of sharing information?
- What are other IT systems used in the cooperation?
- What problems occur in using the coordination mechanisms, and how can these problems be improved?

3 Methodology

This research follows the applied research perspective as described by Kumar (2014). The chosen perspective for the objectives of the research is that of explanatory research since little is known about the research topic (Kumar, 2014). This is combined with descriptive research in order to describe systematically the situation (Kumar, 2014). The mode of enquiry perspective is that of a qualitative approach (Kumar, 2014) and therefore the form of case studies is chosen to retain a holistic and real-world perspective (Yin, 2013). A case study is interpretive and descriptive because it attempts to understand and portray results-oriented planned maintenance through the participants' interpretation of their context (Runeson & Höst, 2009). The case study design is also chosen because (i) the main research question is a 'how' question, (ii) the researcher has no control over actual behavioural events, and (iii) the degree of focus is on contemporary events (Yin, 2013).

The research aims to discover which coordination mechanisms are used (i) to align goals and objectives in the supply chain, (ii) to align decision-making by the supply chain partners, (iii) to share information within the supply chain, and (iv) to align cooperation in the supply chain. But also to discover whether the benefits of SCP (e.g. (i) improved project performance (e.g. project coordination, work processes, problem solving processes, organizational learning, quality of project results), (ii) reduced project costs (e.g. less redundant work and wastage), and (iii) reduced project risks (project delay, over-budget, poor quality) (Arvitrida, Robinson, & Tako, 2015; Bresnen, 2007; Challender, Farrell, & Sherratt, 2014; Love, Irani, Cheng, & Li, 2002; Soosay & Hyland, 2015; Vrijhoef & de Ridder, 2007; Wong & Cheung, 2004) are present in the cases. Further objectives are to investigate what ICT systems are used, the problems that occur in using the coordination mechanisms, and how these problems can be improved.

This research consists of two (replicable) cases. For these cases, a two-case case study design (Yin, 2013) is chosen in order to describe and explain SCP in planned maintenance at Dutch housing associations. The findings from these cases are assessed in a wider context through a survey. Research results are published four times during the research. The first paper is a literature review, the second paper is based on the results of the first case study, the third paper is based on the results of the second case study, and the fourth paper is based on the survey results. The final thesis is composed based on the published papers (see also figure 1).

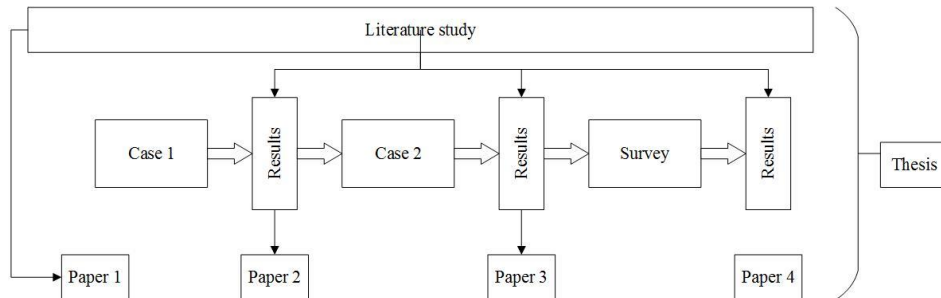


Figure 1: Research method (Goedknecht, 2017)

The coordination processes of supply chain integration at Dutch housing associations are described through a literature study. This is supported by literature on coordination theory, agency theory, boundary crossing, and information management. Literature is found through desk research and snowballing using scientific databases such as Science Direct and scholar.google.com. Results of this literature review will be used in the case studies. Case study evidence may come from six sources: documents, archival records, interviews, direct observations, participant observations, and physical artefacts (Yin, 2013). And because in case study research it is important to use multiple sources of evidence (Yin, 2013), this research makes use of the following sources: documents, archival records, interviews, and direct observations. The researcher will not participate in the maintenance process, therefore participant observation is not used. The researcher remains “a passive observer, watching and listening to activities and drawing conclusions from this” (Kumar, 2014). Also, physical artefacts are not used because processes are researched, not technical operations (Yin, 2013). Furthermore, two types of interviews will be used: prolonged case study interviews (“in which interviewees can be asked about their interpretations and opinions about people and events or their insights, explanations, and meanings related to certain occurrences”) and survey interviews (Yin, 2013). The direct observations will contain observations of meetings and maintenance activities (Yin, 2013).

Both case studies are organised to the same theory in order to strive for generalizable findings (analytic generalisations) that go beyond the specific cases (Yin, 2013). This means that this research adopts the holistic multiple-case design and is a literal replication

of two cases as described by Yin (2013). In all cases (i) maintenance must be executed within a supply chain; (ii) within the supply chain all partners commit to predetermined results; (iii) maintenance is described by the housing association (in consultation with tenants and the contractor) as technical performance demands; and (iv) the contractor assures both housing association and tenants that the technical performances are achieved. Results from both case studies will be validated (or rejected) through a survey amongst other Dutch housings associations and their maintenance contractors.

The first object of study is a maintenance supply chain at a local Dutch housing association, founded in 1913. For this housing association, supply chain partnering is an important feature since 2011. They believe in the benefits of SCP and execute 80% of their maintenance work through SCP. In this case study, the main contractor is a new supply chain partner who has proven his reliability and skills in a small project. The following roles are included in the study: the project manager of the housing association, the foreman of the main contractor, the project manager of the most important subcontractor(s) and the project manager of the (main) supplier(s). It is important to point out that the project that is researched is the first of this particular main contractor. Aspects of study are the sub-questions as stated in section two. In more detail, it is researched what mechanisms are in place to establish supply chain integration for the maintenance activities using coordination mechanisms and boundary crossing mechanisms (see table 1). The first column in table 1 shows the supply chain integration mechanisms (after Briscoe & Dainty, 2005). The second and third column show matching coordination and boundary crossing mechanisms for each of the supply chain integration mechanisms. In the fourth column, the matching maintenance activities are added. In other words, the table shows what maintenance activities contribute to supply chain integration.

Table 1: Conceptual model (Goedknecht, 2017)

Supply chain integration (Briscoe & Dainty, 2005)	Coordination mechanisms (Kanda & Deshmukh, 2008; Koolwijk et al., 2015; Li & Wang, 2007; Malone & Crowston, 1990; Malone & Crowston, 1994)	Boundary crossing (Akkerman & Bakker, 2011)	Maintenance (construction) activities (Lavikka et al., 2015; Tucker et al., 2014)
Develop effective communication systems throughout the phases of the supply chain, Ensure good and reliable flows of information, Establish mechanisms for problem resolution.	Align decision-making (e.g. through (electronic) meeting and communication tools). Establish standardisation of outputs.	Identification (othering, legitimating co-existence). Coordination (communicative connection, increase boundary permeability, routinization) Reflection (perspective making and taking).	Establish maintenance service standards. Set up collaborative decision-making. Use building information modelling (BIM). Use project management software and techniques.
Ensure that all supply chain partners have knowledge of each other's processes Ensure that all supply chain partners are able to align their processes.	Align goals and objectives within the supply chain.	Transformation (confrontation, recognising shared problem space, hybridization).	Establish a procurement strategy. Establish a joint financial incentive. Set up an organisational design. Agree on a process for collaborative working. Agree on common definitions. Use the pull technique of Lean construction

Focus on coordinated working through (i) project management techniques, and (ii) alignment of ICT-systems (e.g. BIM).	Structure joint working sharing of resources. Establish an ICT-system to transfer information and knowledge (e.g. BIM). Set up SC contracts. Planning project phases together.		Establish efficient work practices. Align work practices. Establish quality control procedures. Key project partners work co-located. Use building information modelling (BIM). Use and project management software and techniques.
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4 Expected results

Based on our study of the literature, the following elements are a prerequisite for the improvement of the maintenance processes (see figure 2) (Goedknecht & Ravesteijn, 2016): (i) supply chain partners have a joint understanding of the mutual (inter)dependencies between all supply chain partners; (ii) supply chain partners align their goals and objectives; (iii) supply chain partners agree on the coordination of decision-making; and (iv) supply chain partners agree on the exchange and availability of information and knowledge (regarding the maintenance processes). The assumption is that by identifying and applying the coordination mechanisms (see figure 2), information management (through implementing BIM) and supply chain partnering, and thus maintenance processes will improve. This will lead to all previously mentioned benefits (e.g. improved project performance, reduced costs, and reduced project risks).

Preliminary case study observations (of the first case study) show a difference in the approach to SCP. The property managers ambition is results-oriented cooperation with a permanent network of supply chain partners based on affordability, availability, and quality. He believes that data must be secured and available and knowledge must be assured, for example by using BIM. The project manager, however, does not talk about results-oriented cooperation but about performance oriented cooperation with responsible supply chain partners. He also draws up performance oriented contracts per project which contravenes to both the literature on trust and SCP and the housing association's own supply chain principles. The main contractor has aligned his goals with those of the housing association regarding the project, he puts the quality of living of the tenants during and after the maintenance activities first. Further research must give more insight into the actual cooperation process and its effects.

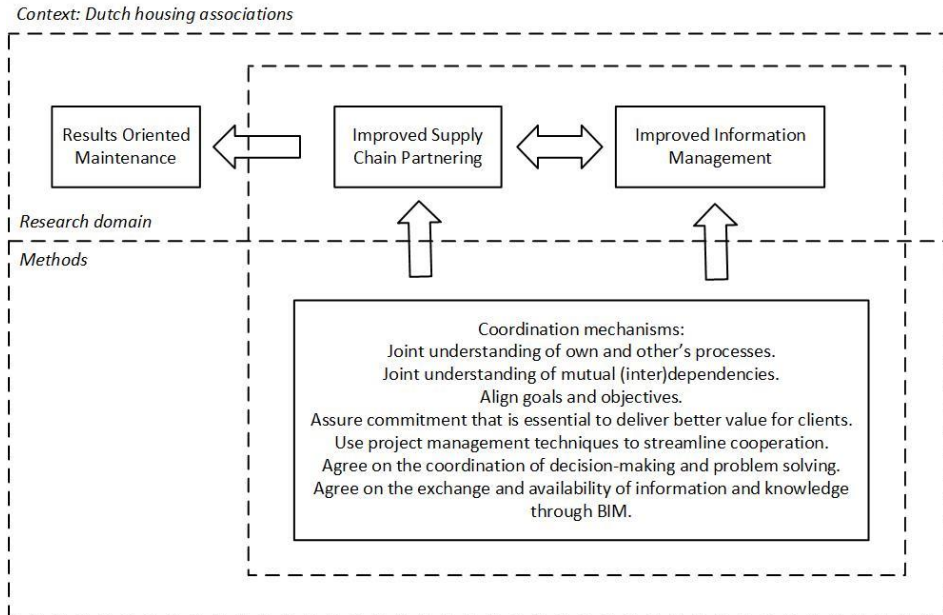


Figure 2: Conceptual model (Goedknecht, 2017)

5 Future Development

The literature study is the rationale for subsequent future research. Although more scientific and practical research can be incorporated, this study has already shown that research regarding improving maintenance processes at Dutch housing associations is missing. Therefore, research will be executed through case studies at two Dutch housing associations currently implementing results-oriented maintenance processes. These case studies aim to reveal how the different constructs in our conceptual model help improve the information management, supply chain management and thus the maintenance processes. These results will then be tested via a qualitative survey with relevant stakeholders (e.g. housing associations, main contractors, subcontractors). This will contribute to the implementation of SCP in the construction industry. According to Van der Boon (manager R&D, innovation, business development) at Leertouwer (a technical service provider in electrical engineering, climate control and ICT) many housing associations are still stuck in the previous century, steering at lowest cost based on Excel documents, sometimes even lacking the knowledge and skills to see the bigger picture (Van der Boon, 2016). Van der Boon (2016) also stresses that although SCP is very relevant, construction is still an industry where phases are viewed as stand-alone, and learning across phases is still not common. When one phase is finished, information is not well nurtured, and cooperation and coordination are not common. Communication is key, and a change in culture is necessary. It is important to understand the role, responsibilities and processes of all actors. Wolf (managing director of Vines Building

Engineers) states that BIM, as a vehicle for improving the coordination of information of maintenance processes, can be used to change the current maintenance processes into processes based on sharing knowledge and information and empowering process stakeholders (Wolf, 2014).

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Personalization in Digital Services: Information Technology Supporting Service Personalization Process

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Abstract Personalization technologies are widely applied for providing appropriate products and services for individual users. Service providers utilize personalization technologies for understanding the individual user needs, and for personalizing their service offerings for those needs. That perspective follows the value models of manufacturing, wherein service provider personalizes the services for the user, and where the roles of service provider and user are distinct. However, propositions that markets have transformed to services, wherein services are co-created between actors, is not supporting the traditional personalization perspective properly. For example, healthcare services are not only personalized for the user, but in co-creation with the user. Therefore in my research proposal, the aim is to examine service personalization, and the role of IT in the service personalization process, from the perspectives of different actors.

Keywords: • Personalization • Service Design • Healthcare Service • Service-Dominant Logic • Human-Computer Interaction •

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1 Introduction

Personalization has remained an increasingly intriguing concept among scholars (Sunikka and Bragge, 2012). Through the digitization of everything (Brynjolfsson and McAfee, 2014), more and more information about user preferences is available for service providers (Salonen and Karjaluoto, 2016). Rapidly evolving digital technology provides novel platforms and channels for service delivery (Vehmas et al., 2015), and consequently for personalization (Sunikka and Bragge, 2012). In principle, personalization consists of two core components: 1) The understanding of user needs and 2) personalization of services based on those needs (Kaptein and Parviainen, 2015). In both these components, a wide variety of personalization technologies, such as recommendation systems are utilized. In other words, the purpose of personalization is to adapt standardized products or services to the individual user needs, and that personalization is carried out by the marketer on behalf of the user (Montgomery and Smith, 2009).

The concept of personalization is often used interchangeably with another one-to-one marketing concept, customization, which on the contrary is user-led, and where the user proactively “personalizes” the service elements from the marketing mix, based on their own preferences (Kwon and Kim, 2012; Salonen and Karjaluoto, 2016). In this research, we follow the viewpoint from Sunikka and Bragge (2008) who view personalization as an umbrella term, including other closely related concepts like customization.

Based on the aforementioned personalization principles, it can be argued that personalization is a service provider-led concept, where service provider decides the suitable services for an individual user, based on the information gathered. These viewpoints follow the value models of manufacturing (Lusch and Vargo, 2014), where the service provider personalizes the services for users, who then receive the services, for example in the forms of product recommendations. However, unlike manufacturing and tangible products, services, often intangible by their nature, are carried out in collaboration (co-creation) between actors (Vargo and Lusch, 2004). The service delivery may also involve more actors than service provider and the user only. Therefore, instead of emphasizing the distinction, where the marketer carries out personalization and the user receives the personalization, it is important to examine personalization from the different actors’ viewpoints, as with services, the actors together construct the personalized service.

2 Problem Definition

Personalization has remained a puzzling concept among scholars for decades (Sunikka and Bragge, 2008). The scholars in information systems (IS), computer science, economics, services, and marketing have studied the concept through different lenses, with an aim to optimize services to the individualized user needs (Fan and Poole, 2006; Kwon and Kim, 2012). In the IS field, personalization is typically technologically

emphasized, studied in the web context and examined from the perspective of a single software (Sunikka and Bragge, 2012). That viewpoint has typically included two primary actors into the personalization process. 1) The service provider, who personalizes the service offerings, and 2) the user, who receives the personalized service offerings. This distinction follows the value models of manufacturing (Goods-Dominant Logic, G-D), where companies produce (create) value and users consume (destroy) that value (Lusch and Vargo, 2014). Companies try to understand users' needs, and to personalize the service offerings for those needs. In order to do so, different information technology (IT) solutions, such as personalization technologies are widely adopted.

However, Service-Dominant Logic (S-D) has challenged this thinking by proposing that markets have shifted from manufacturing and goods-dominance to services (Vargo and Lusch, 2004; Lusch and Vargo, 2014; Häikiö and Koivumäki, 2016). Unlike tangible products, services can be defined as: “the application of specialized competences (knowledge and skills) through deeds, processes, and performances for the benefit of another actor or the actor itself” (Vargo and Lusch, 2004). In other words, any act done intentionally for benefiting an actor can be considered as a service. Services are often intangible by their nature, but are occasionally supported by tangible products. In contrast to products though, the value in services is bound to knowledge and skills that are delivered (co-created) in exchanges between actors.

In my research plan, the aim is to examine personalization of digital services through S-D logic lens, and the role IT plays in the service personalization process. Unlike concrete products, intangible services can consist of multiple steps and phases, and often involve multiple actors in the service delivery process. That can be illustrated with a healthcare example, where the primary purpose of a healthcare company is not to sell tangible products to patients, but to serve the patients' needs collaboratively with by the patient. Furthermore, this service can be supported by tangible devices, like monitors for self-measurements, and involve multiple actors, such as medical doctor, patient, or the healthcare service provider that together construct the personalized service. The aim of my research is therefore to answer to the following questions:

- How IT supported personalization can be viewed from the perspective of different actors taking part in the service delivery?
- How and what support IT can provide for different actors in the service personalization process?

3 Research Methodology

My research will apply qualitative research methods, but also quantitative methods may be used to support the findings. The primary material for my research comes from two case studies (Eisenhardt, 1989), conducted in collaboration with two large service providers. The data from those case studies consists of service documentations and the interviews (semi-structured interviews and focus groups) with the people who have been

designing the services under analysis. The data is collected and analyzed iteratively throughout the studies using qualitative data analysis approach (Miles and Huberman, 1994), with an aim to interpret and construct understanding of the situation where the examined phenomenon takes place (Klein and Myers, 1999). For example, in the case study (paper 3), two focus groups were conducted first, for getting an overview of the problem area. In the focus groups, more general and open-ended questions were discussed, with an aim to gain understanding of the unit of analysis (which in that case was a depression care pathway). Second, the findings from the focus groups were used to formulate the themes for the semi-structured interviews, where the aim was to ask detailed questions from the key informants that were selected by selective sampling technique (Sandelowski, 1995). In practice, those were the medical doctors that had been designing the examined care pathway. After the semi-structured interviews, the findings were categorized thematically and summarized into a table form. Third, a validating interview was conducted for validating the prior findings and to provide potentially complementary data.

In the future, the plan is to utilize similar settings in another case study (paper 4) regarding to the service provider perspective. For the user perspective (paper 5), user experiences (e.g. Forlizzi and Battarbee, 2004) will be collected using different types of interviews (as it was done in paper 1). That data can also be supported by quantitative data, in the forms of surveys that the service provider has already conducted with the service users.

In addition to aforementioned case studies, other qualitative analysis methods are used in single papers, such as Nexus analysis (Scollon, 2004) to deepen the understanding on user experiences about motivation for exercising (paper 1) and Interaction analysis (Jordan and Henderson, 1995) for studying service interaction between user and service clerk in a context of technology-mediated car rental service (paper 2).

4 Preliminary/Expected Results

In overall, by covering the viewpoints of different actors, the aim of my research is to increase the understanding of value creation between different actors for personalized services in the framework of S-D logic and to examine the role of IT in the service personalization process. As a technology-emphasized concept, personalization is mostly studied using the G-D logic principles and with the value models of manufacturing. Due to the idea of market transformation to services, it is important to examine personalization 1) in the service context, 2) from the different actors' perspectives, and 3) to provide knowledge on the versatile role of IT in the service personalization process. Therefore the planned articles for examining the phenomenon are presented in the Table 1.

Regarding to the preliminary findings, we have conducted an interpretive case study (Klein and Myers, 1999) for examining IT support for personalization in the healthcare service context (paper 3). In healthcare services, personalization is provided as a premise as individual conditions and needs vary between healthcare users (Berry and Bendapudi,

2007). As medical doctors are specialists in the healthcare domain, the services are typically personalized based on their professional knowledge for individual healthcare users, with support from IT and other tangible technology (such as laboratory measurement devices). In other words, IT is used as an artefact to provide the right information for the right person, in the right format (Von Thiele Schwarz, 2016). Therefore our study focused on examining the role of IT in the healthcare service personalization process. Our results from that study illustrate that personalization intertwines automatized support from IT with a more collaborative nature where service personalization occurs in co-creation and interaction between actors.

Therefore, for illustrating our findings (from paper 3), we categorized different personalization types under three main categories, based on the automatization level provided by IT: 1) Coercive personalization is automatized and does not allow interpretation of the human actor, 2) Data display personalization is automatized, but interpreted manually by medical doctors, 3) Collaboration-based personalization is supported by automatization, but the emphasis is on interpretation and co-creation between actors.

Table 1: Planned articles for the doctoral research

Paper	Perspective	Role of technology	Results
#1 Personalized Gamification: Narratives for Supporting Motivation for Exercising.	User (experiences)	Application, designed to entertain/support exercising	The focus on examining the use of narratives as a motivational feature – proposing three techniques for narrative personalization
#2 Service Interaction Flow Analysis Technique for Service Personalization.	Analysis of the technology-mediated interaction between user and service clerk	Enables technology-mediated communication	The focus on capturing evidence on how variations of service flows can be made visible in the technology-mediated service environment.
#3 Identifying Personalization In A Care Pathway: A Single-Case Study Of The Finnish Healthcare Service Provider	Medical doctor (service designer)	Intertwining the role from support that is primarily automatized, to supportive, that provides interpretative data for co-creation between actors	IT support for healthcare service personalization, based on the automatization level provided by IT: 1) Coercive personalization, 2) Data display, 3) Collaboration-based personalization
#4 Personalization in the healthcare service: Case study of a remote measurement device ½ (DRAFT)	Service provider perspective (Either designer or company)	Technology enables remote measurements and communication between actors (patient and service provider)	In the future (2017)
#5 Personalization in the healthcare service: Case study of a remote measurement device 2/2 (DRAFT)	User (patient) perspective	Technology enables remote measurements and communication between actors (patient and service provider)	In the future (2017-18)
#6 (Optional) Synthesis of the case study findings (DRAFT)	Holistic (all actors)	Framework of the IT support for service personalization	In the future (2018)

5 Future Development

In the near future, we have plans to conduct another case study in collaboration with a large service provider (paper 4 and 5). The aim is to examine both the user and service designer (or company) perspective and to provide insights how the personalized services are constructed in co-creation between these actors, and what is the role IT plays in the service co-creation. For the final paper (paper 6), the aim is to draw an overview, a holistic framework regarding to service personalization. That framework covers the perspectives of different actors and presents the diverse role of IT in the service personalization process.

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