Zbornik 17. mednarodne multikonference

INFORMACIJSKA DRUŽBA – IS 2014

Zvezek D

Proceedings of the 17th International Multiconference

INFORMATION SOCIETY – IS 2014

Volume D

Sodelovanje, programska oprema in storitve v informacijski družbi
Collaboration, Software and Services in Information Society

Uredil / Edited by
Marjan Heričko

http://is.ijs.si

8. oktober 2014 / October 8th, 2014
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PREDGOVOR MULTIKONFERENCI INFORMACIJSKA DRUŽBA 2014

Multikonferenca Informacijska družba (http://is.ijs.si) s sedemnajsto zaporedno prireditvijo postaja tradicionalna kvalitetna srednjeevropska konferenca na področju informacijske družbe, računalništva in informatike. Informacijska družba, znanje in umetna inteligenca se razvijajo čedalje hitreje. Čedalje več pokazateljev kaže, da prehajamo v naslednje civilizacijsko obdobje. Npr. v nekaterih državah je dovoljena samostojna vožnja inteligentnih avtomobilov, na trgu pa je moč dobiti kar nekaj pogosto prodajanih tipov avtomobilov z avtonomnimi funkcijami kot »lane assist«. Hkrati pa so konflikti sodobne družbe čedalje bolj nerazumljivi.

Letos smo v multikonferenco povezali dvanajst odličnih neodvisnih konferenc in delavnic. Predstavljenih bo okoli 200 referatov, prireditev bodo spremljale okrogle mize, razprave ter posebni dogodki kot svečana podelitev nagrad. Referati so objavljeni v zbornikih multikonference, izbrani prispevki bodo izšli tudi v posebnih številkah dveh znanstvenih revij, od katerih je ena Informatica, ki se ponaša s 37-letno tradicijo odlične evropske znanstvene revije.

Multikonferenco Informacijska družba 2014 sestavljajo naslednje samostojne konference:

- Inteligentni sistemi
- Izkopavanje znanja in podatkovna skladišča
- Sodelovanje, programska oprema in storitve v informacijski družbi
- Soočanje z demografskimi izzivi
- Vzgoja in izobraževanje v informacijski družbi
- Kognitivna znanost
- Robotika
- Jezikovne tehnologije
- Interakcija človek-računalnik v informacijski družbi
- Prva študentska konferenca s področja računalništva
- Okolijska ergonomija in fiziologija
- Delavnica Chiron.

Soorganizatorji in podporniki konference so različne raziskovalne in pedagoške institucije in združenja, med njimi tudi ACM Slovenija, SLAIS in IAS. V imenu organizatorjev konference se želimo posebej zahvaliti udeležencem za njihove dragocene prispevke in priložnost, da z nami delijo svoje izkušnje o informacijski družbi. Zahvaljujemo se tudi recenzentom za njihovo pomoč pri recenziranju.

V 2014 bomo drugič podelili nagrado za življenjske dosežke v čast Donalda Michija in Alana Turinga. Nagrado Michie-Turing za izjemen življenjski prispevek k razvoju in promociji informacijske družbe je prejel prof. dr. Janez Grad. Priznanje za dosežek leta je pripadlo dr. Janezu Demšarju. V letu 2014 četrtič podeljujemo nagrado »informacijska limona« in »informacijska jagoda« za najbolj (ne)uspešne poteze v zvezi z informacijsko družbo. Limono je dobila nerodna izvedba piškotkov, jagodo pa Google Street view, ker je končno posnel Slovenijo. Čestitke nagrajencem!

Niko Zimic, predsednik programskega odbora
Matjaž Gams, predsednik organizacijskega odbora

FOREWORD - INFORMATION SOCIETY 2014

The Information Society Multiconference (http://is.ijs.si) has become one of the traditional leading conferences in Central Europe devoted to information society. In its 17th year, we deliver a broad range of topics in the open academic environment fostering new ideas which makes our event unique among similar conferences, promoting key visions in interactive, innovative ways. As knowledge progresses even faster, it seems that we are indeed approaching a new civilization era. For example, several countries allow autonomous card driving, and several car models enable autonomous functions such as "lane assist". At the same time, however, it is hard to understand growing conflicts in the human civilization.

The Multiconference is running in parallel sessions with 200 presentations of scientific papers, presented in twelve independent events. The papers are published in the Web conference proceedings, and a selection of them in special issues of two journals. One of them is Informatica with its 37 years of tradition in excellent research publications.

The Information Society 2014 Multiconference consists of the following conferences and workshops:

- Intelligent Systems
- Cognitive Science
- Data Mining and Data Warehouses
- Collaboration, Software and Services in Information Society
- Demographic Challenges
- Robotics
- Language Technologies
- Human-Computer Interaction in Information Society
- Education in Information Society
- 1st Student Computer Science Research Conference
- Environmental Ergonomics and Psysiology
- Chiron Workshop.

The Multiconference is co-organized and supported by several major research institutions and societies, among them ACM Slovenia, SLAIS and IAS.

In 2014, the award for life-long outstanding contributions was delivered in memory of Donald Michie and Alan Turing for a second consecutive year. The Programme and Organizing Committees decided to award the Prof. Dr. Janez Grad with the Michie-Turing Award. In addition, a reward for current achievements was pronounced to Prof. Dr. Janez Demšar. The information strawberry is pronounced to Google street view for incorporating Slovenia, while the information lemon goes to cookies for awkward introduction. Congratulations!

On behalf of the conference organizers we would like to thank all participants for their valuable contribution and their interest in this event, and particularly the reviewers for their thorough reviews.

Niko Zimic, Programme Committee Chair
Matjaž Gams, Organizing Committee Chair

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PREDGOVOR / PREFACE

This year, the conference "Collaboration, Software and Services in Information Society" is being organized for the fourteenth time as a part of the "Information Society" multi-conference. As in previous years, the papers from this year's proceedings address actual challenges and best practices related to successful collaboration as well as to service and software engineering. It is important to note that, from a technical point of view, ICT-based services are designed and architectured in a way that provides adequate performance even in the case of handling a large amount of data produced from the Internet of Things. However, even technically perfect services and solutions will not be accepted by consumers if developers do not take into account the specifics and needs of real users as well as other factors that influence acceptance. Therefore, it is crucial to combine concepts, approaches, methods and theories from different domains and disciplines, whereas pilot projects and case studies assist in identifying and establishing best practices.

We hope that these proceedings will be beneficial for your reference and that the information in this volume will be useful for further advancements in both research and industry.

prof. dr. Marjan Heričko
CSS 2014 – Collaboration, Software and Services in Information Society Conference Chair

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THE EVALUATION OF CONVERGENCE EVOLUTION PROCESS OF NANO-BIO-INFO-COGNO TECHNOLOGIES

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ABSTRACT

We are entering a new technological period of convergence and the internet of the future is becoming the Internet of Things (IoT). The scientific review paper represents the concept of convergent nano-, bio-, info- and cognitive technologies (the international abbreviation is NBIC technologies). We consider that in this connection an effective observation and measurement of the convergence phenomenon is crucial and not covered in scientific literature. Based on the theories of NBIC convergence, its areas and factors, the natural life cycle of new media evolution, new economy phenomena, the indicators of the innovation system and the theory of real options we will develop an evolutionary model of NBIC convergence. This paper presents the theoretical basis for developing the model and highlights our intended further research on business evaluation of the convergence process.

1 INTRODUCTION

Advanced technologies have consequently changed our lives, values, ethics and principles. IoT is a set of products, services and processes that virtualizes the real-world things for digital processing and its outcome is a digital representation of the real world that can interact with digital systems and applications and is susceptible to internet business models [1]. The phenomenon of convergence is showing in various fields of technology and science which happened for the first time in the history of human society. Technological progress depends even more on the scientific progress, where the competitive digital economy is vital. Convergent technologies have an important role there. Today many people get most of their information through complex combinations of text, images and sounds. We need to be able to navigate this multifaceted media environment. Therefore, we aim to create the evolutionary model of convergence, which will allow the observation and measurement of the process of convergence. Convergence brings the idea of reducing the digital divide, because it is about popularization and mass consumption of multifunctional devices and integrated services. That is why in the connection with convergence economic and technological aspects are primarily exposed, although that convergence phenomena extent to other levels, too. The concept of convergence eludes the precise definition, but it is generally assumed that its foundation denotes that different networks are capable to transfer digitized information via devices that allow transmission, processing and storage of digital data.

2 PRINCIPAL THEORETICAL FRAMEWORK

In the following subsections we present the principal theories of the planned complete option valuation of the convergence process and the development of the evolutionary model of NBIC convergence.

2.1 NBIC tetrahedron

NBIC tetrahedron indicated in Figure 1 is the starting point for the analysis of convergence, which was originally proposed by Roco and Bainbridge in the scientific report of the first NBIC conference [2].

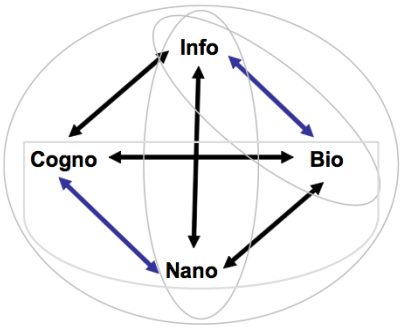

Figure 1: *NBIC tetrahedron* [2].

In the introductory article they claim, that the phrase 'convergent technologies' occurs as a synergistic combination of four major 'NBIC' (nano-bio-info-cogno) branches of science and technology [2]: (a) *nanoscience and nanotechnology*, (b) *biotechnology and biomedicine*, including genetic engineering, (c) *information technology*, including advanced computing and communications, (d) *cognitive science*, including cognitive neuroscience.
In our view, the advantage of their theory is, that it first draw the attention to the phenomenon of increasing interlacing and integration between advanced technologies and fields of science. However, its disadvantage we see in focusing only on the cooperation between several scientific disciplines instead of addressing the integration of research approaches, tools and systems more specifically. Our following literature review shows that this drawback might be overcome.

2.2 Areas of technological convergence

Beckert with co-author's believe that in the article of Roco and Bainbridge the question that remains unanswered is whether convergence is something already happening and comes together under a new label of convergence, or it is something necessary in the future to enable scientific breakthroughs [3]. Beckert adds that the answer to this question is a combined approach of individual areas of convergent technologies. They formed the following eight core areas of convergent technologies [3]: (a) *neuro and brain enhancement*, (b) *physical enhancement and biomedicine*, (c) *synthetic biology*, including a further five areas: (d) *human-machine interfaces*, (e) *sensors*, (f) *computer-based modelling of the world*, (g) *pattern recognition*, and (h) *robots and intelligent software and devices*. Beckert with co-author's write that looking at all eight fields, no pattern or 'lead convergence' could be found. The convergence is required almost everywhere, encompassing very different subfields and subdisciplines. We believe that this requires a detailed technical and methodological evaluation, which is done in section 3 of this paper.

2.3 Factors of technological convergence

Trillion Dollar Challenge dealing with potential markets in the era of merging technologies exposes the forefront four factors that enable and encourage convergence. These factors are [4]: (A) *Digitization*, which allows the transfer, processing, storage and display of data on electronic devices. (B) Inseparable parts of the *connectivity* are broadband and mobility. The main benefits of improving connectivity are: (a) *to ease communication*, (b) *common use of hardware*, (c) *sharing of files, data and information*, (d) *sharing programs workload* and (e) *the preservation* and *archiving information*. (C) *Technological advances* in the technology sectors enable innovation and the increasing storage capacity and data processing, which is a driver of competitiveness. (D) The Factor *New users* perceives the lifestyle users as essential for promoting convergence processes, based on availability of technology everywhere and always. New users are consumers who will adopt the new technology by acclamation, as well as participate in its creation. Last but not least they will be also prepared to pay for it.
The key theoretical contribution of the presented factors is not only the framework for enabling and encouraging convergence, but also opportunities for identification and evaluation of potential new markets for convergent technologies. Matthias Krieb also writes about the company's strategic options in the context of digital convergence [5]. According to him the various sectors of information and communication industries are based on various technical concepts presented in the following subsections.

2.4 The natural life cycle of new media

Technical and technological concepts of the convergence phenomenon have also been studied by Lehman-Wilzig and Cohen-Avigdor. They research the development of the internet and its impact on the so called old media, which struggling for survival in new and growing media landscape. The analysis is based on a 6-stage, natural life cycle model of new media evolution [6]: *comprising birth (technical invention)*, *market penetration*, *growth*, *maturation*, *defensive resistance and adaptation*, *convergence or obsolescence*. Individual stages are briefly described in Figure 2.

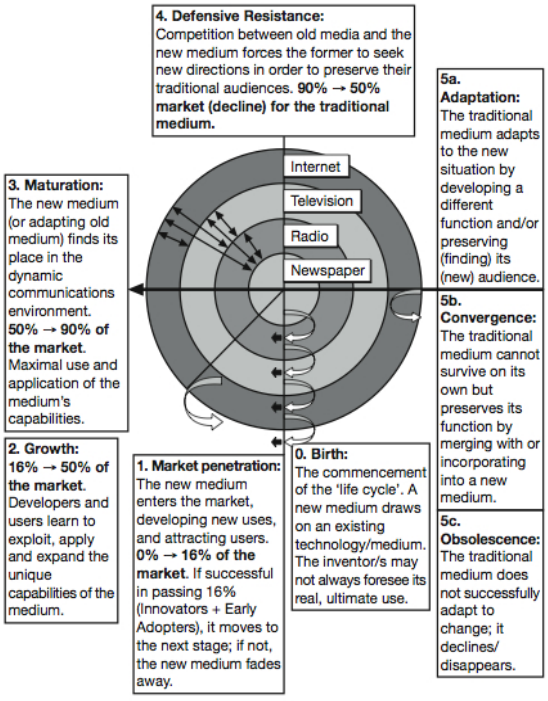

Figure 2: *Natural life cycle model of new media evolution* [6].

The model can also be transferred to the area of convergent NBIC technologies. The authors of the evolution of the media also focus on the Beal-Bohlen model 'Diffusion of

Innovation'. Thus, in their model the process of transferring innovation (new ideas, opinions, or products) through certain channels over time among the members of social system is incorporated [7].

2.5 Phenomena of new economy

Contemporary social system has also led to changes in the economy, which must be taken into account in the evaluation of convergence process. Tapscott argues twelve phenomena that shape the character and image of the new economy [8]: *knowledge*, *digitization*, *virtualization*, *molecularization*, *convergence*, *disintermediation*, *innovation*, *prosumption*, *integration/internetworking*, *immediacy*, *globalization* and *discordance*. We only briefly outline few of them. *Knowledge*: in the new economy knowledge is the driver and other traditional resources are secondary. *Virtualization*: in the new economy it is possible to convert physical and tangible things into virtual things. *Convergence*: the dominant economic sector is being created by the convergence of computing, communications and content. These together create the interactive multimedia. *Innovation*: the new economy is based on innovation using information technology to develop new products and services. McKeown similarly marked new economy as a combination of enhanced, modified or new economic relations based on computer network and also human knowledge [9].

2.6 Condition indicators of research and innovation system

The convergence process and the development of convergent technologies in addition to the economic impact also affect the research and innovation environment. Therefore we will based on a snapshot of the research and innovation system in Slovenia, which is presented in the document of the Ministry of High Education, Science and Technology [10], also develop a model of a complete option valuation of convergence. The document summarizes the current status of research and innovation system in Slovenia based on the findings of various studies [11] [12]. Slovenia's vision is to establish a responsive research and innovation system by the year 2020. The success of achieving this goal is influenced by several factors, which are summarized: a) *management of research and innovation system*, b) *investing in science and innovation*, c) *human resources*, d) *open, excellent and attractive system*, *e*) *efficiency of research and innovation activities* and f) *effects on the economy*.
Even Roco, which together with Bainbridge formed one of the main theories included in our research, in his recent articles outlines six key indicators for the evaluation of investments in nanotechnology and connecting scientific breakthrough and technological use [13]. For example, the number of researchers involved in different domains of nanotechnology, inventions reflected by the number of patent applications field etc. By including these condition indicators of research and innovation system in our model, we will be able to verify the research, development and innovation ability of enterprises or educational institutions. We see this as an urgent precondition for research, development and innovation in the field of convergent technologies.

3 EVALUATION OF THE CONVERGENCE PROCESS

By studying the process of convergence it is essential to design measurement parameters that will be developed and evaluated further in the research using the theory of real options. The theory will be represented a mathematical test of the evolutionary model of NBIC convergence. The valuation of real options will be based on the work of Fischer Black and Myron Scholes. They introduced in 1973 the first successful model for the evaluation of options that can be applied to simple call and put options [14]. Their mathematical model was awarded with the Nobel Prize and has led to a sharp growth of financial markets. The valuation of real options is a multidisciplinary field, which includes knowledge of microeconomics, finance, management and information technologies, and is therefore very complex task for managers who carry out such evaluation [15].

4 NBIC OCTAHEDRON

Since the real options allow a more realistic evaluation of investment projects and consequently more correct decision making, our intention is also to develop the model for valuing investments in convergent products.

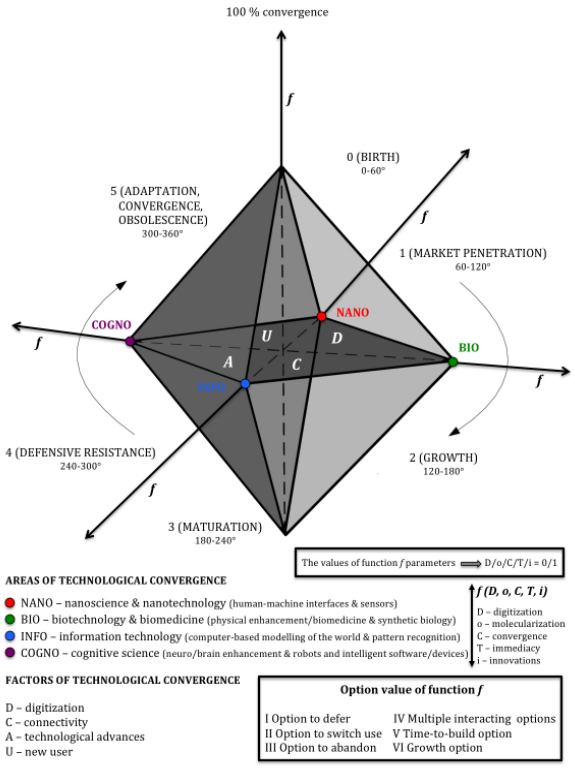

Figure 3: *Octahedron - evolutionary model of NBIC convergence*.

In Figure 3, we present our octahedron, the evolutionary model of NBIC convergence that we intend to use for a complete option valuation of convergence. Its design considers all relevant findings of the previous research. A more detailed theoretical and empirical treatment of the model and the theory of real options is the content of our further study.

5 OUR INTENDED RESEARCH METHODOLOGY

For the empirical research we chose the methodology of the multiple case studies of Yin [16]. One of the goals of studying multiple cases is the construction of generally accepted statements that correspond to each case study. By using this methodology in contrast to sampling of a traditional survey research is a logic of repetition similar to repetition when using experiments. Each case of study must be carefully selected, so that results can be compared. Only by following the strickt methodology in using case studies results can be assumed as reliable and credible. The developed model of a complete option valuation of convergence will be based on data of primary and secondary sources for which collection in real environment is adviced by verified theoretical analysis. According to theory we will create a structured questionnaire-guided interview, and form the coding sheet for the quantitative evaluation of qualitative rates of tracking projects on the phenomena of new economy, checking types of real options and the qualitative value of the projects' options. With the coding sheet we will examine the R&D and innovation capacity of companies or institutions.

6 CONCLUSION

Convergence of science and technology means the phenomenon of even greater connection and integration of various basic theoretical and applied fields. Therefore in our research we approach 'convergent' to the evolution of NBIC technologies. This means that we combine the theory of information convergence and the real options theory, i.e. information technology field and the economy, a key discipline in social sciences. With the development of the NBIC convergence evolutionary model, theoretically based on different key areas of convergence, we will evaluate the option value of convergent and information technologies for companies and other institutions.

Convergence can only happen when different disciplines and technology fields come together and combine methods, approaches, concepts and insights. The evolutionary model of NBIC convergence could be the starting point to companies or scientific research institutions for developing models for evaluating investments in the European market of convergent technologies.

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COLLABORATIVE GREEN ICT PILOTS TO SUPPORT SUSTAINABLE DEVELOPMENT

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ABSTRACT

The ICT sector plays a key role in addressing climate change globally and facilitating efficient and low-carbon development. A Green ICT project was established in 2012 in the Satakunta region of Finland. One of the main aims of the project was to improve the operational environment of enterprises through green ICT solutions that support sustainable development. The most tangible results are the technology pilots that were implemented during the project. This paper introduces the pilots and also the results of the survey related to the criteria set for the suitability and potential of green ICT themes to support the business activities of local companies.

1 INTRODUCTION

The ICT sector plays a key role in addressing climate change globally and facilitating efficient and low-carbon development. This includes not only a reduction in emissions and savings in the ICT industry itself, but also the benefits of ICT applications in order to influence and shift the way our society works and the way people behave. ICT provides a means for optimizing systems and processes to make them more efficient. In this way, many industries can make use of modern ICT technology to penetrate higher efficiency, low-carbon markets. The SMART 2020 report [1] gives a wide overview of how key a player the ICT sector itself is and how can it contribute to achieving a low-carbon society. Webb [1] presents the case of a future-oriented ICT industry that responds quickly to the challenge of global warming. Thus, it is fair to say that the ICT industry has both a beneficial side and a critical role to play with other sectors in order to design and deploy the solutions needed to create a low-carbon society. López et al. [2] state that ICT can reshape the social model, providing the means to address the growing environmental concerns, and thereby reinforcing the information society's commitment to sustainable development. Moreover, there is a multiplicity of literature which classifies the different fields where ICT can make a more sustainable impact [3],[4],[5]. For instance Figure 1 shows a classification based on ICT activities. According to the diagram, all kinds of sustainable software should be selected and included in one of these four groups: systems which improve energy efficiency, applications which reduce product transportation, efficient improvement of production, or environmental measurements.

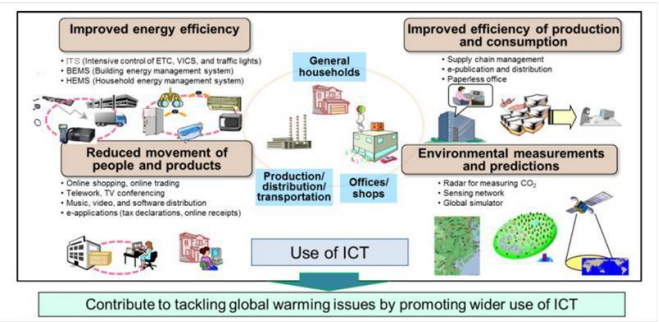

Figure 1: *Using ICT to reduce environmental load - Green by ICT [6].*

The Green ICT project was established in 2012 at Tampere University of Technology (TUT) Pori department. One of the main aims of this two-year development project was to improve the operational environment of local enterprises through green ICT solutions that support sustainable development. In the Green ICT project, the concept of sustainability is defined as including environmental, social, and economic aspects [7]. This definition was the basis in the search for relevant themes for technology pilots. Moreover, the focus was more on the "green by ICT" approach rather than the ICT devices (hardware) themselves. It can be stated that Green ICT is not an end in itself, but includes the use of ICT solutions in order to support smart growth. In addition, the SMART 2020 report [1] provides a good reference for this theme.

The most concrete results of the project were the *technology pilots*, which were also the most extensive and central parts, in terms of both time and workload. It was first needed to find relevant themes for them and after that it was necessary to set up an appropriate consortium for the entire technology pilot, and finally to make accurate specifications for each of the pilots. When the suitable technology pilot theme and piloting customer companies were found and finalized, the pilot suppliers (technology providers) were selected by

official open bidding. The project was funded by the local public funding organization - the Centre for Economic Development, Transport and the Environment (ELY) [8] with the City of Pori and the EU Regional Social Fund. In this type of funded project, the normal procedure is to run the pilots in order to get experience and results for public reports [9]. The following section introduces briefly the four technology trials implemented during the Green ICT project.

2 IMPLEMENTED TECHNOLOGY PILOTS

The function of the technology pilots was to try and indicate the viability of green ICT and the opportunities it enables from the point of view of different business sectors. In each of the pilots, at least two enterprises/organizations and one or more suppliers were chosen to take part, depending on the technology and know-how package demanded by the pilot. In this project all suppliers are local small and medium enterprises (SMEs) from the Satakunta region. Below we present the four technology pilots that have been completed so far.

2.1 Technology pilot 1: Saving energy with embedded IT

The objective of the pilot was to test a new procedure for vehicle block heater junction boxes in order to reduce electricity consumption. By means of the pilot, experience was gained concerning the convenience and reliability of energy-saving embedded IT and the savings achieved in electricity consumption by using measurements and calculation comparisons in contrast with conventional ways (traditional timers) were proved. It is typical for car power sockets that the cylinder-block heater is connected manually. However, this is neither an economic nor ecological option. In this case the piloting device was called a "smart car power socket" (left in Figure 2). The device, developed by Porel Ltd, optimizes the moment the heating starts according to the prevailing temperature.

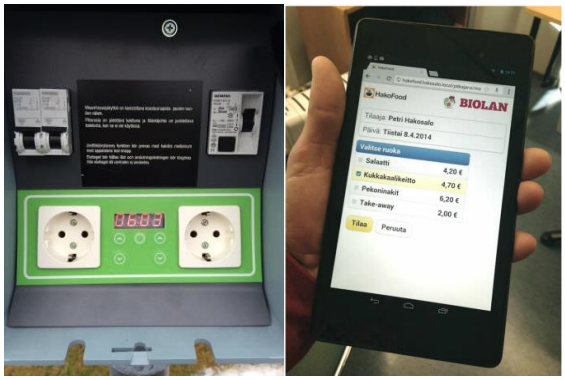

Figure 2: *Smart car power sockt (left) and Food order equipment user interface/Tablet device (right).*

Energy conservation was estimated in the pilot by measuring the period of time the heater was switched on and comparing this to various usage scenarios.

The pilot results suggest that with the smart car power socket, energy can be conserved without reducing usability. Measurement results [9] indicate that energy savings can be achieved with this piloting technology. The pilot demonstrates a clear savings potential in comparison with the conventional timer. The benefits brought about by the control technology in the form of energy savings in relation to extra costs of car power sockets is considered significant. This justifies the purchase of the smart technology for example in new builds or when renewing old block heater outlets.

2.2 Technology pilot 2: Improved accessibility of individual services in areas of dispersed settlement

The general objective of the pilot was to increase and improve services and their availability and accessibility in an area of dispersed settlement as well as making the suppliers' competitiveness more scalable in order to reduce the barriers caused by variations in demand by means of an example that is both concrete and can be introduced immediately.

One particular objective of the pilot was to implement the additional services of an ordering system exploiting modern, yet proven technology, such as for example NFC (near-field communication) and mobile data terminals. These services should aid management of food orders and deliveries, decrease food losses and improve the overall quality of the service. The functionalities of the pilot also aimed to verify actualized deliveries as well as enabling reception of immediate feedback on delivered products and services. Another objective was to collect statistical data on eating and variation in lunch amounts depending on the day, week and dish for the development, planning and optimization of food ordering.

In the first case, NFC close reading application (Nexus tablet) was used in the pilot (right in Figure 2). In this case, food orders were saved in the pilot system in real time. The piloted technology, which was hardware- and platform-independent, made it unnecessary for companies and end users to install any additional equipment; the only thing required was a web browser and network connection.

The second case started out by attempting to improve the management of lunch subscriptions and deliveries in areas of dispersed settlement. The objective was to replace the current telephone and paper subscription system by modernizing the subscription and delivery process with a more reliable and easily manageable information system, which would aid both the subscribers and the lunch providers.

In both pilot cases, the objectives were well achieved [9] and we can state that there is demand for this type of system and operation, especially in areas of dispersed settlement. As for web services, for example small enterprise activity and quality home living for the elderly can be facilitated and enabled in the countryside and other sparsely populated areas as well. In conclusion, the piloted system, developed

by Hakosoft Ltd, was stated to have saved working time in the receiving of preorders and in billing, facilitated the management of menus, clarified procedures and processes, improved the quality of customer-specific service and improved accessibility.

2.3 Technology pilot 3: Real-time information services for mobile working

The objective of the pilot was to put into use various real-time and user-specific information services that can be utilized with portable data terminal equipment in order to support and intensify nursing and care work demanding mobility. The composition of information services required in quality care work as well as the integration and adaptation of information transmitted to the user were implemented with a separate integration solution. The application is intended to sustain an automatic work record and support task management flexibly.

Makea Mobile Ltd realized an application for instruction, control, and reporting of home care service work. The application exploited in the mobile device aids and speeds up the fieldworkers of the piloting company by means of automatic and real-time features. This means that working hours are instantly liberated for client work. The piloted system included two components: an Application and a Service platform. The Application is the end user's, in other words, a mobile worker's tool (see Figure 3 below). The Service platform enables mobility in different information systems. The pilot was carried out on Windows phones, but all main mobile platforms (Windows, Android and iOS) are supported.

Figure 3: *Basic view of a worker's application*.

The piloting result [9] shows that the modernization of the current system with advanced mobile technology was successful. In further development, diverse reporting alternatives will be developed and the special requirements of other services, such as the cleaning, property and catering services of the piloting organization, will be taken into account as well.

2.4 Technology pilot 4: RFID technology in raw material procurement network control

The objective of the pilot was to evaluate the suitability, implementation, deployment and exploitation of an RFID system executed as a cloud service in a network of partner companies operating in the same geographical area. With the RFID systems, various identification and tracking procedures can be automated. The identification is based on radio frequency (in other words wireless technology) and thereby enables a cost-effective way to swiftly identify large volumes in a very short time. The objective was to test the functionality of a concept based on RFID technology [9] as well as modeling the operational concept in an application environment, including many subcontractors and other operators under one main operator. In this case, the flow and circulation of raw material modules (chicken transportation unit) were monitored in the various stages of the production process.

With the RFID technology, a considerable amount of measures for surveillance, planning and optimization of operations can be connected to the process cycle of the raw material. In this pilot, UHF RFID tags were mounted on the raw material modules chosen for the pilot (75 cages). In addition, three chicken transportation trucks were also fitted with corresponding tags. Moreover, the piloted system also covers ten different identification points along the cycle (see Figure 4 below). The objective of the pilot was to examine the functionality and suitability of the passive UHF RFID technology in the optimization of the raw material supply chain and to test the opportunities brought by NFC and GPS technologies in implementing the tracking system.

Figure 4: *Tagged modules and identification point (RFID reader gate)*

The pilot was implemented with EasyRFID concept created by Riffid Ltd. In this system all the identification points transmit their data to a cloud service with a www-based user interface. This way the system does not need to be integrated with any of the current systems at any time. In this case, the achieved benefits included a transparent logistic supply chain, accurate observation of timetables and improved delivery reliability and more accurate information about the origins of the product, and the handling of the live poultry in question.

Based on the results [9], the piloted technology (RFID) seems to be highly functional and suitable for this kind of

raw material cycle process control as well. After the piloting period, the piloting food producing company has started a plan to expand the system and extend implementation of the technology to its other production processes.

3 POTENTIAL ADOPTION OF SOME GREEN ICT SOLUTIONS IN SATAKUNTA

We also gathered ideas and examples of the software and systems that could be classified as Smart applications, or in other words, Green by ICT solutions. We were able to identify nine categories, with one of the boundary conditions that at least one solution provider for each category had to be from Satakunta.

Our categories were Mobile desktop, Cloud services, Software for remote work, Management of energy consumption, RFID, Route optimization, Conditions of a built-up environment, Mobile work management, and Energy harvesting. We compiled a survey using the eDelfoi system [10], which is a web-based software tool. We described each of the themes in such a way that the respondents were able to evaluate if that particular type of Green ICT solution would be worthwhile to them. We also asked which business sectors might benefit if the particular solution was adopted in the respondent's organization.

The survey was sent in May 2014 to over 250 business managers in the Satakunta region, mainly from small and medium enterprises (SMEs) but there were also some representatives from bigger enterprises. Everyone was allowed to answer only the themes that they wished to answer. In all 210 evaluations were received from 43 different respondents.

After analysis of the results, we were able to compile a hypothetical assertion of the potentiality of the different kinds of Green by ICT solutions in Satakunta. The lower part of each column shows this potentiality in Figure 5 below.

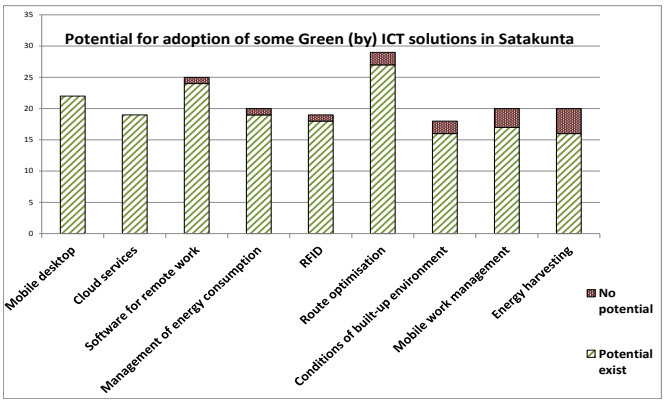

Figure 5: *Potentiality of Green ICT solutions in Satakunta.*

As can be seen from Figure 5, the themes "Route optimization", "Software for remote work" and "Mobile desktop" were mentioned most often and only a few answers were interpreted as "No Potential" which is illustrated at the upper part of the columns. As a conclusion, we wanted to emphasize the applicability of Green ICT solutions. For companies this fact offers business benefits and marketing possibilities for differentiating themselves from rivals that are not yet using Green ICT solutions.

4 SUMMARY

This paper presented the technology pilots implemented in the context of Green ICT. It gave some examples of how currently available technologies could be utilized for supporting and enhancing a sustainable way of doing and developing business. The goal of supporting the deployment of green technology in the project was to pilot green technology solutions for sustainable development. The result of the trials proved that the piloted technologies were promising candidates for promoting sustainability in different kinds of business environments. In the future, our research will continue by focusing on the other green ICT themes evaluated by companies via a web-based survey. The survey results show that there seems to be a lot of potential and interest in this topical and vital research subject.

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ADOPTION OF 24ALIFE MOBILE APPLICATION: A PILOT STUDY

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ABSTRACT

Due to the wide spread of smart phones, mobile applications have become an important part of users every-day use information technology. Mobile application 24alife, which is the main subject of this paper, can be classified as a mobile application for health and fitness type of mobile solutions. The aim of this paper is development of a research model for studying factors that have significant impact on user's decision whether he or she will adopt and use 24alife solution. Technology Acceptance Model (TAM) was used as a ground theory for developing the theoretical model. A pilot study using 19 test users was conducted to empirically validate the proposed research model and measurement items. Reliability and validity of measurement items were tested with Cronbach's α, used for estimating the extent to which multiple indicators for a latent variable belong together. The constructs showed a reasonable level of reliability for almost all proposed items.

1 INTRODUCTION

Mobile applications (Apps) are computer programs, running on mobile devices, such as smartphones and tablet computers. Apps can be obtained through several distribution platforms for each mobile operating system (iOS, Android). Although present on the market for a relative short period of time, they have (together with smart phones) changed several aspects of user's access to technology.

This study is about studying factors that affect user's perceptions when using a mobile solition, called 24alife. 24alife, accessible at http://www.24alife.com, is a complete solution providing a web portal and mobile application supporting the user on the way to a healthier, more active and less stressful life. The solution provides services, available on web portal as well as on the mobile device for tests, training programs, demonstrations, and personalized analysis allowing holistic support in planning, executing and monitoring progress towards a healthier lifestyle. An initial in-depth analysis provides the user with a goal that can be achieved with 24alife guidance, combining 4 key fields – Sport, Psychology, Medicine and Nutrition. The solution keeps records and simultaneously forms an explicit graphical representation of ongoing progress. Figure 1 provides some screenshots from the mobile application.

The main focus of this study is to estimate how well the described solution is adopted and used by end users. In this paper, development of the research model and measurement instrument is described and empirical validation of the proposed research model is presented.

The paper is organized as follows. In next section, theoretical backgrounds and a literature review are given. In section that follows, a theoretical model for assessing the adoption of the 24alife application is proposed. In section 4, the results of the pilot study are presented. The paper concludes with a discussion and directions for future research activities.

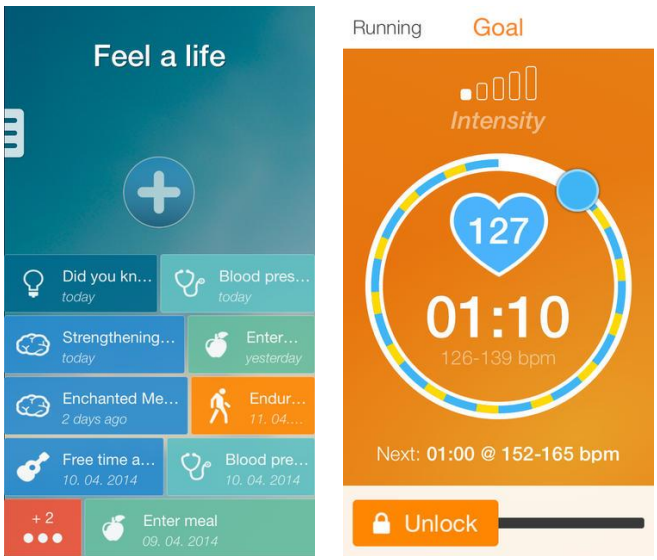

Figure 1: *Screenshots from the 24alife mobile application*

2 THEORETICAL BACKGROUNDS

Studies, dealing with identification of factors and assessment of their impact on user's decision whether he or she will accept and use a certain information technology (IT) or information system (IS), are usually based on one the proved and accepted technology acceptance theories. The most common theory in the field of adoption is

Technology Acceptance Model – TAM [1]. Davis proposed TAM to explain the potential user's behavioral intention to use a technological innovation. Over the time TAM has progressed through a rigorous development process since it has flexibility to be extended. Results across studies revealed several antecedent factors to perceived usefulness and perceived ease of use. TAM has become one of the most widely used models in IS because of its understandability and simplicity [2] and is applicable to different information technologies. A complete overview about the evolution of TAM, its main applications and limitations was presented in [3] with conclusion that existing research in TAM lacks sufficient rigor and relevance that would make it a well-established theory for the IS community.

There are also other theories, which are being used in adoption research: Unified Theory of Acceptance and Use of Technology (UTAUT), Task Technology Fit (TTF), Theory of Planned Behavior (TPB) and Innovation Diffusion Theory (IDT). In existing literature, two types of acceptance studies are being published:

(1) studies, which are validating the basic theoretical model (e.g. TAM or other acceptance model) in in a certain technology setting, and
(2) studies, aiming to extend the basic research model from the underlying theory. In order to provide a more complete picture of the technology acceptance process, authors usually extend the original theoretical model using different types of factors: (a) factors that are specific to the investigated context, (b) factors that are prior to the theory factors, (c) consequent factors or theory implications and (d) combined factors that combine the basic research theory with other theories.

A systematic literature conducted by Shaikh et al. [4] analyzed research on mobile banking adoption and showed that in existing literature different adoption theories are being used, where 42% of studies used TAM, 16% of research papers included IDT and 13% UTAUT. Most common factors that are being assessed are were attitude toward using (ATU), behavior intention (BI), and usage (USE), affected mostly by compatibility, perceived usability (PU), and perceived ease of use (PEOU) serving as antecedents for both ATU and BI [4].

Existing studies, addressing adoption of mobile technology, are mostly focused on adoption of financial, health and marketing oriented mobile applications. Several studies try to compare the adoption in different regions or among different user groups. Ansari et al. in [5] addressed mobile phone adoption and appropriation among the young generation on 253 respondents. Song et al. [6] explored regional differences in Chinese consumer acceptance of new mobile technology, comparing the results through regions. Shieh et al. analyzed factors that affect the adoption of mobile services in Taiwan [7]. Son et al. researched acceptance of mobile computing devices in South Korea [8]. The results of these two studies confirmed the PU as the most significant factor. PU and PEOU were confirmed as significant determinants also in [9], where authors studied mobile marketing acceptance across three influential markets in US, Europe and Chine. Sim and all used TAM model to understand motivators of mobile music acceptance [10]. Their study also showed that PU is the most important factor followed by PEOU. PU, SE, compatibility and PEOU were found to be significant determinants of BI health oriented mobile applications [11], [12]. In case of mobile business applications, several researches provided similar results; PU having the largest effect on BI, followed by PEOU [13]–[16]. Adoption of financial mobile applications was also addressed in [17], researching mobile banking services. Their study showed that performance expectancy is the most significant determining factor. Another study [18], which was based on the UTAUT model, verified that performance expectancy, social influence, and perceived cost can significantly influence user's behavioral intention in case of acceptance of mobile searches.

3 PROPOSAL FOR THE THEORETICAL MODEL

In this study, TAM was used as a ground theory for constructing the theoretical model, because the TAM model is the most common and validated model being used in existing literature. The aim of this study was to identify external factors, which may have a significant impact on user's perceptions when using the 24alife mobile application. We proposed following external factors (see Figure 2): performance, UI quality, information quality, satisfaction, job relevance, anxiety, self-efficacy, perceived risk and trust.

Based on the proposed theoretical model, a questionnaire was developed. The questions were organized into the following groups: (1) demographic questions about the respondents' gender, age, years of study, internet experience, experience, etc.; and (2) measures for the constructs in the proposed research model (see Figure 2). The measures for the constructs were adapted from different existing studies (see Table I). The measuring items were Likert-like items on a 7-point scale from ‘‘strongly agree” to ‘‘strongly disagree”. Because of the space limit, the questionnaire wasn't included in this paper.

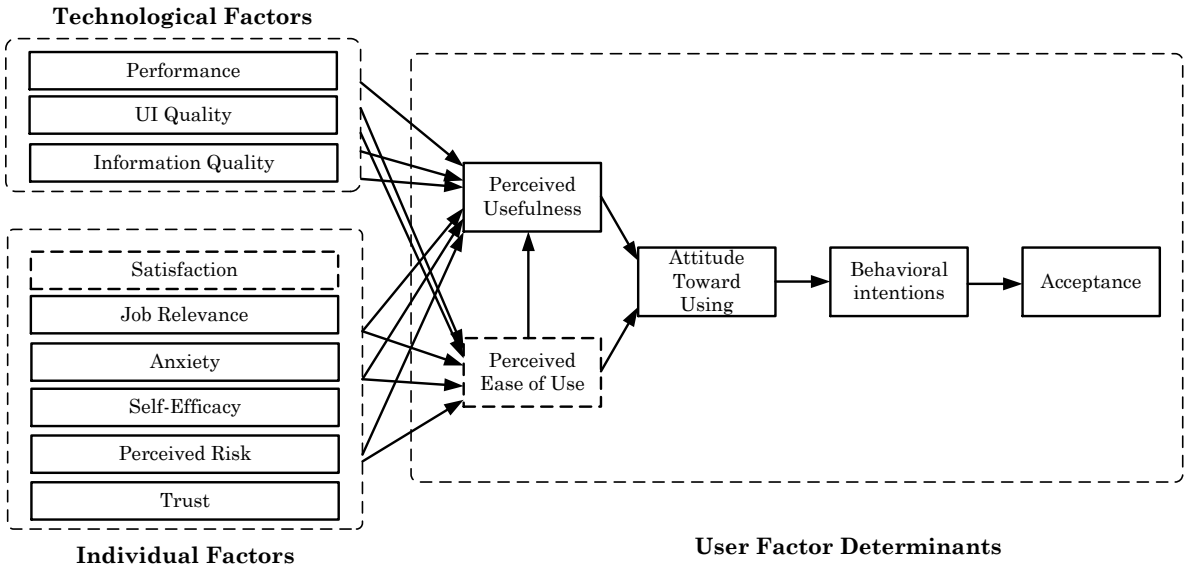

Figure 2: *The proposed theoretical model for assessing acceptance of 24alife mobile application*

Table I. *Sources for construction of the measurement items*

Item	Adapted from
Percieved Usefulness, Perceived Ease of Use	[1]
Attitude Toward Using, Behavioral Intentions, Acceptance, Self-Efficacy, Anxiety, Self-Efficacy, Anxiety	[19]
Satisfaction	[20]
Job Relevance	[21]
Perceived Risk	[22]
Trust	[23]
Performance, UI Quality, Information Quality	own items

4 PILOT STUDY

To reduce measurement error, the development of the online questionnaire involved the following steps. First, a pre-test of the questionnaire was performed. The main goal of the pre-test was to improve the content of the measuring items, therefore colleagues from the Faculty of Electrical Engineering and Computer Science, Maribor were asked to examine the questionnaire for meaningfulness, relevance and clarity. According to the feedback, few measurement items were refined in wording. After the pre-test, a pilot test of the questionnaire was performed with a non-random sample of nineteen volunteers from the same faculty. The pilot study was conducted in February 2014. The main goal of the pilot test was to empirically validate the reliability of the questionnaire – to check whether the measurement instrument lacked accuracy or precision. Data collected from the pilot test was analyzed using SPSS to conduct internal consistency of the measurement items. The statistical test results confirmed a solid reliability for all measurement items.

4.2 Reliability Analysis

Measurement items were assessed for construct reliability and validity. Internal consistency of the constructs was assessed by Cronbach's α, which is a common test being used for estimating the extent to which multiple indicators for a latent variable belong together. Except in case of the Performance, estimated Cronbach's α values for all constructs exceeded the cut-off value of 0.70 [24], thus the constructs showed a reasonable level of reliability for almost all measurement items (see Table II).

Table II. *Instrument reliability and validity*

Factor	Cronbach's α
Perceived Ease of Use	0.762
Perceived Usefulness	0.902
Attitude Toward Using	0.864
Behavioral Intentions	0.856
Acceptance and Use	0.752
Satisfaction	0.918
Perceived Fun	0.700
Playfulness	0.875
Relevance With Training	0.893
Anxiety	0.732
Self-Efficacy	0.700
Perceived Risk	0.847
Trust	0.966
User Interface Quality	0.869
Performance	0.645
Information Quality	0.910

5 DISCUSSION AND FUTURE RESEARCH ACTIVITIES

To evaluate adoption of a mobile application 24alife, a questionnaire was developed and tested. Before sending the survey to a larger number of correspondents, a pilot survey was conducted, described in this paper. TAM was used, including several factors, effecting PU and PEOU. The pilot study was conducted on 19 test users; Cronbach's α values were estimated, providing results of a reasonable level of reliability.

In our future work, we plan to conduct a survey on a larger set of end users, in order to get data for testing the causal paths from the proposed theoretical model. Our future research will aim to identify which of the proposed factors have largest impact on user's behavioral intentions and attitude toward using the mobile application 24alife.

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THE IMPORTANCE OF USABILITY TESTING TO IDENTIFY THE CAUSES OF DECLINE IN USE OF WEB SERVICES

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ABSTRACT

In recent years, Pošta Slovenije has witnessed the decline of telegram services, which they attribute to the use of alternative ways of communication and expressing greetings with use of e-cards, SMS, MMS etc. This may be due to changes in technology and habits over time as well as the lack of offers in the market. However there is no verifiable evidence. According to literature review there exists a connection between usability and consumer behaviour. Our research checked if there are any critical usability issues with the web application for submiting telegrams, which could influence the decline in submitting telegrams.

1 INTRODUCTION

The spread of the internet has heavily influenced the use of other media and greatly changed many traditional services. Companies have been forced to change their working practices, thinking and to refocus their direction of development. Some companies have transformed skillfully and successfully, however some use methodologies which bring only short-term success such as extensive advertising.
In the article we address a traditional service embedded into the world wide web, the Pošta Slovenije's web application for submitting telegrams. We think, with some adjustments there is a potential for further use and development of the service. But not only the concept of the application, also the user experience is very important.
In our research we focused on usability. We performed usability test of the application for telegrams submission, from which we wanted to find usability issues, that could affect the number of submitted telegrams.
Simultaneously we tried to determine opinion about usability from a users' perspective.

2 USABILITY

With technological development and increasing use of personal computers the concept of usability has expanded. Human-computer interaction is based on, and includes, the information technology, psychology, design, communication studies, cognitive science, computer science, etc. [1]

Technical and functional perfection are very important characteristics of products, as is the usability of the product itself and the user experience.
Usability has been defined through several models. One of the most renowned experts in the field of usability evaluation Jakob Nielsen has identified the following components of usability [2]:

- **Learnability** addresses how easy it is for users to accomplish the basics of the interface the first time they encounter it. "Learnability is important since interface with good learnability allows users faster and more efficient use. In addition the degree of learnability is influenced also by the type of user (novice or expert)." [3, p. 7]
- **Efficiency** tells us how fast users can perform tasks after they have learned the design.
- **Memorability** represents how fast users can reestablish proficiency after a period of not using the interface.
- **Errors** how many errors users make, how severe they are and how easily can they recover from the errors.
- **Satisfaction** is as important as other attributes, while it usually influences the possibility that a user will use the design again.

Figure 1: *Components of usability by Jakob Nielsen [2]*

Similarly ISO standard 9126 defines usability as "the capability of the software product to be understood, learned, used and attractive to the user, when used under specified conditions." [4]

3.1 From usability to user experience

Usability is part of the broader field of user experience, which deals with user experience while interacting with the system. Initially it was understood that the usability of a product was particularly important. However in recent years greater importance has been attributed to the more comprehensive field, the user experience.

User experience is a broader concept than usability as well as it exceeds efficiency, quality of tasks and loosely defined user satisfaction namely by considering cognitive, emotional, social and physical aspects of interaction. [5]

Usability has therefore been placed in a broader concept, however it remains an important aspect while it represent one of the factors of quality assurance and above all it has been proved to be crucial factor with internet services. [6] [7] [8]

Garret [9] defined the elements of user experience with a diagram (figure 2) over an decade ago. We can still use it as a tool or basis for interpretation of what user experience means and which are the elements of user experience development.

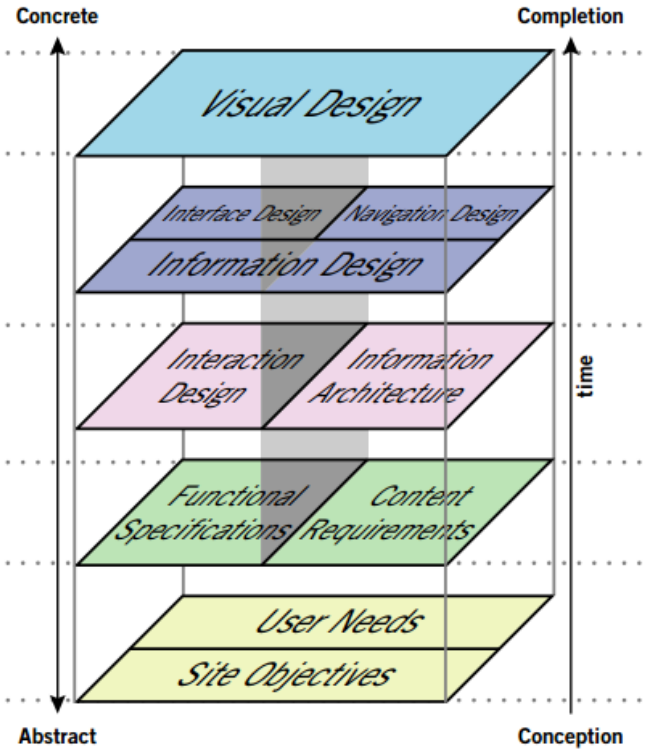

Figure 2: *Part of Garrets diagram which represent elements of user experience development. [9]*

4 THE USABILITY RESEARCH OF THE WEB APPLICATION FOR TELEGRAMS SUBMISSION

Many business sectors have had to change greatly due to fast technological changes in recent decades. Many traditional services transformed into web services or at least traditional services were provided with online support.

Usability of information systems that have desktop as well as web interfaces was researching Benbunan-Fich. Benbunan-Fich [6] observed usability is crucially important with commercial web pages, especially where educating users is not possible. Better usability leads to better interaction between the user and a web page, as it can contribute to purchasing. Cases, that Benbunan-Fich researched can be associated with the example we have researched. The application for telegrams submission is also a traditional service integrated to the web, so it connects the digital to the analog world.

4.1 Research methods

With the research conducted we wanted to observe whether there are any usability issues, which we could indirectly associate with the drop in telegrams submission and which are those usability issues. Nevertheless our goal was to identify users' opinion about usability of the web application.

The research questions are:

Q1: Are there any usability issues with the application?

Q2: Do users find the application easy to use?

Q3: Would users want to use the application more, if it would be improved?

There are different methods and techniques for usability evaluation (usability testing, discount usability engineering, heuristic evaluation etc.) We decided to use a combination of methods and questionnaires that would cover our research questions.

Firstly, participants had to answer a few demographical questions. This was followed by a usability test, consisted from six short tasks. Participants were encouraged to use the think-aloud method. At the end of the test participants had to answer SUS questionare as well as additional questions about their intentions of using the application in the future.

We decided to use usability testing as it is a well established testing method. Furthermore we could observe and compare qualitative (behavioral metrics like strong positive/negative comment, suggestion for improvement, expressed frustration etc.) as well as quantitative (time of task performance, degree of task success, average task success, number of clicks) metrics.

SUS or System Usability Scale was developed by John Brooke in 1986. It consists of ten arguments that cover different areas of software usability. [10] Participant evaluate their agreement or disagreement with given arguments within five-step scale.

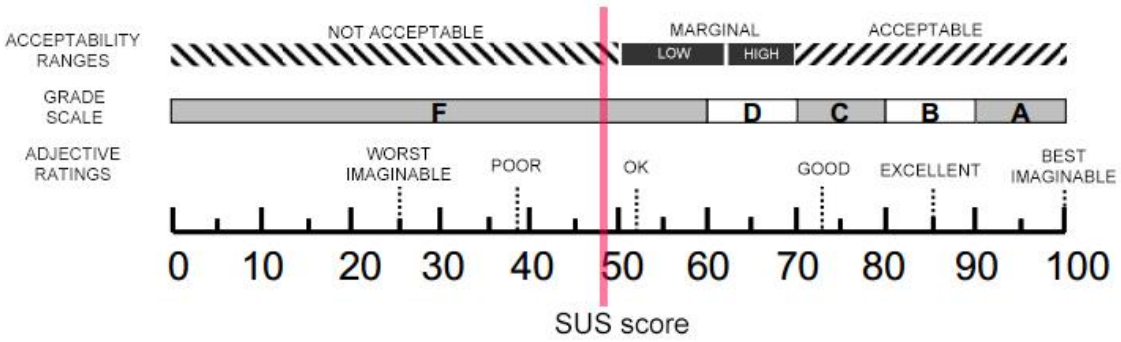

Figure 3*: The SUS result*

The whole execution of the test was recorded with software Morae[1].

According to findings in research that explore the optimal number of participants according to number of issues found [11] [12] we decided to invite 10 potential participants, of whom 9 responded. Potential participants were randomly selected among acquaintances of the researcher. The participants were 4 men and 5 women, aged between 23 and 59. All of the participants use the internet at least for browsing and e-mail, 89% of them have already made an online purchase. 78% of the participants have never used the tested web application for telegrams submission prior to the test.

4.2 Data analysis

With the conducted testing we have obtained a series of quantitative and qualitative data:

- perceived usability issues,
- quantitative data of time spent for a task and task performance/success,
- observation notes (participants' frustrations)
- participants' comments,
- demographical data about participants,
- quantitative data conducted by SUS (participants' subjective opinions),
- audio and video recordings.

Initialy we statistically analysed the quantitative data; demographic data about participants, data conducted from the usability test (time spent on task, task successfulness, average clicks count, correlation between average time, successfulness and clicks count). Next we analysed qualitative data (participants' comments and evident common expressions like tilting head closer to monitor, scratching head etc.). Those analysis were followed by the triangulation method with goals to evaluate the web application's usability. Accordingly we compared results from those diverse methods (quantitative and qualitative data from usability test, SUS) and finally evaluated the studied application's usability as poor.

[1] Morae is a tool for usability testing from TechSmith. For our execution of the test version 3.3 was used. More about Morae: http://www.techsmith.com/morae.html

We determined several usability issues (shown in table 1) and therefore we can answer the first research question "Are there any usability issues with the application?" affirmatively.

Table 1: *Summary of determined usability issues with frequency of occurrence. (Issues visually exposed are the most frequent.)*

Usability issue description	Frequency (%)
Difficulties with finding the right link for telegrams submission.	56
Unclear meaning of "the location first letter".	56
Difficulties with drop-down menu for location selection.	100
Poor visibility of the motif categories menu.	89
Poor visibility of the basket, unclear if an item was added to the basket and lack of transparency of which items are already in the basket.	100
Unclear navigational elements respectively titles of buttons "enter", "add gift") and poor visibility of the"add to basket" link.	89
Unclear navigation (unclear where user is and lack of button for returning to previous step.	33
Lack of clarity of the left menu.	44
Poor recovery after an error (difficulties with returning to the previous state).	44

The SUS result suggest, users do not find the application as easy to use. The position of identified SUS result is shown on figure 3. The answer to the second research question "Do users find the application easy to use?" is therefore no.

Analyzing answers to the additional question about intentions to more frequent use of the application in the

future if the application would undergo improvements, we found correlation between usability and intentions for more frequent use. Most of the participants answered they would like to use the application again or more frequently if the application would be more “easy to use”, “transparent”, “logical” etc. or they would never like to use it again. It follows we can answer the third research question “Would users want to use the application more, if it would be improved?” adversely.

6 CONCLUSION

With the goal of the usability of the Pošta Slovenije’s web application for telegrams submission evaluation, we conducted the usability test in combination with SUS questionnaire and additional questions about intentions of reuse.

The service we have addressed had a diverse and large group of potential end costumers, however we found testing with relatively small test group very useful. We gained a good insight into the thinking of users as well as achieving a good starting point for further in-depth analysis or user experience design for a modern, renewed web application.

We determined significant number of key usability issues, the elimination of which no major technical challenges exists and could be eliminated quickly and with little effort.

The tool Morae, which was used during usability test, has been proved to be effective, while it offers various insights into user’s thinking and supports a qualitative analysis of the data.

The SUS questionnaire has proved to be slightly problematic, as the given arguments can be ambigous. Therefore, the participants understood the arguments differently. After analyzing the recordings we found some participants read the arguments too superficially. In future that could be improved with larger test groups or greater clarification of the arguments.

In general the selected combination of methods has proved to be adequate, since we managed to answer all of the research questions. We obtained the information that provide good support for further researching of user experience.

We can not directly associate the decline of telegrams submission to the poor usability of the application for telegrams submission, although based on the analysis of existing research about the link between usability and loyality, it can be assumed that improved usability would contribute to the increased use of the web application.

Although it is a relatively obsolete service, according to the findings of the research, we see a potential in the application. For successful transformation of the application, we suggest user experience design, which will include both usability testing as the use of different techniques of user experience design like card sorting for better information architecture, analysis with use of personas etc.

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REAL-TIME SYSTEMS: CHOOSING DESIGN PATTERNS BY QOS CONSTRAINTS

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ABSTRACT

The goal of this paper is to provide an understanding of roles that design patterns play in creation (modeling and implementing) of real-time systems. Whilst creating such systems there is no (if any) room for errors, as such systems mostly provide critical functionality support whose failure can result in – at best – monetary loss – or at worst – the loss of human life. Thus the result of such a design and implementation should be a powerful, efficient and highly reliable system whose requirements and operating capacity are almost always limited by processor power, available memory size and communication channel capacity. To create such a system that confirm to the demands set up by its QoS (Quality of Service) one could and should rely on design patterns – proven solutions to recurring design challenges.

To meet this objective we will take a look at current classification methodologies for design patterns that can be used in design of a real-time system. We will discern their suitability in light of "rebirth" of interest in real-time systems due to recent emerging or established technologies (Internet of Things (IoT), Unmanned Aerial Vehicles (UAV)) in regard to specific (underlying) QoS and propose a simpler, more abstract classification that will be applied on an already existent pattern catalog.

1 INTRODUCTION

Design patterns, as basis of modeling and implementation solutions, are not solely the domain of business applications but are finding more and more ground in real-time systems due to their complexity and repeating (similar but not equal) QoS demands.

Designers of real-time systems (or real-time components of a system) must invest a great deal of attention to a specific design requirement of real-time systems: they must try to capture all aspects of reliable and safe system operation as required by QoS demands. This is independent of the system under design being a business application (banking application where transactional security is of paramount importance) or a true real-time application (managing fuel injectors in car engines). The emergence of IoT and its rapid expansion that is to follow [1], where estimates predict that by 2020 almost 50 billion devices will be connected to the IoT where 80% of them will be real-time systems (embedded or otherwise).

It is self-evident that other, similar solutions, can be taken and used as a basis for the system under design. Such (multiple) existing solutions are usually distilled of specifics – reduced to general ideas, implementation stubs… – and generally known as design patterns. With their use one can shorten the time needed for modeling, implementation and deployment and also be quite confident that all QoS demands have been met.

2 RELATED WORKS

With the growing number of real-time systems the number of discovered real-time design patterns is also rising. This rise – as beneficial as it seems – has also its drawbacks. The patterns are being grouped into pattern catalogues by various authors, research groups and project managers that are either very specific [2, 3, 4] or general [5, 6, 7, 8]. The design patterns then may be grouped into software based, hardware based or a combination of software and hardware [9] – and this is the lowest common denominator. Making pattern catalogues even more complex is the fact that these various groups have different criteria (or guidelines) how to group design patterns even further. Some authors consider state automata to be the guiding principle [10], others use existing real-time constraints (compliance to deadlines, event duration, latency, jitter) while a third group seeks to introduce more general real-time criteria which are recognized as non-functional requirements (e.g. safety, reliability, modifiability, cost, execution time) [11].

What is an emerging trend is the recognition of trying to use QoS properties [12, 13, 14, 15] to qualify real-time design patterns. The issue with this approach is that different real-time systems have different QoS properties and generalizing them to a more manageable number would be quite a challenge thus no widely accepted formalized way exists.

Therefore we propose a "back-to-basics" approach, where we propose for QoS constraints to be of the highest abstraction level possible. This – in our view – enables a faster start of real-time system creation by making it possible to select a collection of appropriate design patterns that may be used.

3 REAL-TIME SYSTEMS

One can consider real-time systems being a subset of "normal" systems but with a specific time-oriented behavior or defined timely constraints. Their main – and also

distinguishable – property is the timely dependence. It is not enough for such a system to deliver results (e.g. sensor readout value) – the result must be delivered in time. One can interpret this as a requirement to finish a specific task in a given time interval (up to a specific time limit). Based on the timely dependence we distinguish between:

- hard real-time systems – where failure to deliver a result in the given time interval (time limit, deadline) is not allowed
- soft real-time systems – where the delivery of result after the given time interval reduces the usefulness of the result, thereby degrading the system's QoS
- firm real-time systems – where the delivery of result occasionally happens outside of the given time interval is allowed, but then the relative value of such a result is zero; accumulation of such deliveries may degrade the system's QoS

The following technological examples illustrate the affiliation with different types of real-time systems. Consider:

- heart pace makers, industrial process controllers (pharmaceutical reactors), car engine control systems are examples of hard real-time system
- air traffic control system, UAV video streaming (live video streaming) and vast majority of IoT devices are examples of soft real-time systems (learning thermostats – Nest, Eversense, CubeSensors, connected light bulbs) [16, 17, 18, 19]
- car cruise control, navigation controller for UAV, multimedia systems are examples of firm real-time systems

Real-time systems are mostly modeled and implemented as embedded systems. As such they are designed as a set of tasks which work in concert to fulfill a common goal. Embedded systems, based on low-end, cheap microprocessors and microcontrollers, have limited capabilities: small amount of memory, limited processing power and limited communication channel capacity. Thus the main goal of design and implementation of a real-time system is to maximize the use of these limited resources. Before the expansion of IoT the developers needed to worry about the real-time behavior, determinism, reliability and code size. Now the emphasis is growing also in the fields of communication requirements and the need for more stringent security.

4 DESIGN PATTERNS

Simply put a design pattern consists of a context, a problem and the solution to the problem within the given context. It is used for documentation, transfer and use of design knowledge. One can reason that the use of a design pattern is to create a solution to the problem based on existing design knowledge.

It has been shown that a use of design patterns leads to real-time systems that are robustly designed, modular, adaptable and easier to understand [20]. Furthermore, design patterns can be used to express functional (functionality itself) as well as nonfunctional properties of a system (e.g. safety, reliability, modifiability, cost, execution time) [11].

It is worth to note, that some of the design patterns that emerged from the design of specific real-time systems have "migrated" to the underlying real-time operating system. Thus some functionality that would likely be useful to implement via design patterns (e.g. messaging) is maybe left to the operating system then wasting valuable limited resources to support one implemented by the real-time system itself.

4.1 Design Pattern Notation

Considering the object oriented terminology a design pattern identifies collaborating classes and their instances, their roles, interactions and distributed responsibilities. One describes a pattern with [20]:

- name, also known as (if existent), classification
- intent
- motivation
- applicability
- structure
- participants
- collaboration
- consequences
- implementation
- sample code and usage
- known uses
- related patterns

5 CLASSIFICATION OF DESIGN PATTERNS

How can we understand QoS (Quality of Service) in the domain of real-time systems? One of better definitions states that: "QoS is quite vague term which is in general used to separate performance aspects of a system from its functional aspects" [21].

5.1 Current Classification Methodologies

There is currently no well-defined set of classification methodologies that could be applicable to various real-time design patterns or their catalogues. One of the reasons for this is that the discovered real-time design patterns (by pattern mining) are either to specific (a very narrow, mostly performance oriented, set of QoS) – or very general (e.g. resource manager patterns). This can have a very poor influence on selecting appropriate design patterns because:

- the design pattern can be very hard to understand and therefore use because it is focused on very specific QoS parameter (e.g. communication latency under 10ms)
- the design pattern can be too general and at first seem a very good choice for the fulfilling the QoS parameter requirements (e.g. no deadline

missed) but later shown it is not up to the task (should static scheduling verification be done before the deployment or should dynamic scheduling be provided when the system is deployed)

- therefore a design pattern can be "hidden" in either a very general (too big) or very specific pattern catalogue (not knowing it exists)

5.2 Discerning the Suitability of Design Patterns

In light of this, how can we achieve the goal of selecting the most adequate (or most probable to be used) design patterns for a real-time system that is being created (taking its QoS into consideration)? Either a very experienced designer / developer is at hand who has experience with the type of system we are creating or a more general criteria is needed to choose the design patterns.

Consider one of the most basic criteria we have – what kind of real-time system are we developing? Should it be hard, soft or firm real-time system? Each of these comes with a basic set of QoS that should be fulfilled (one of the basic ones is the meeting of deadlines). Furthermore we can extend this criteria by defining some additional general QoS for the real-time system under design. Consider the following examples:

1. UAV – an UAV can be composed of different real-time subsystems, that can be either hard (avionics), soft (video streaming to the base station) and firm (navigational controller) QoS constraints. Additionally a UAV may require in its QoS that effective processor utilization must exceed 70% (e.g. free resources should be allocated to rising the resolution or quality of the video stream) and that frame rate of the transmitted video should not drop below 12 fps.
2. A learning thermostat – usually considered a soft real-time system. If the delivered temperature rate is after a deadline (e.g. a period of 1 second per readout) it can accumulate to a somewhat unfavorable environment (too hot or too cold, increase in heating or cooling costs). Additionally such real-time system might require a very strict communication policy (e.g. all messages – temperature readings – delivered although deadlines missed) because it is still "learning" and security policies (we don't want our neighbor to be able to influence the temperature at our home).

In light of given QoS, how would one choose useful design patterns on the onset of the project?

5.3 Keeping it simple

To answer the question in previous section we propose the following: keep the classification criteria of design patterns simple. Already by using the type of the real-time system and the more basic of its QoS requirements one can select adequate design patterns that may be used in the design of the real-time system at hand.

In the following tables we will show the applicability of design patterns from the pattern catalog [5] to the examples given in the previous paragraph. The applicability of the design patterns will be rated by:

Table 1: Suitability levels

Suitability	
Very suitable	VS
Suitable	S
No recommendation	-
Not suitable	NS

5.4 The UAV and Learning Thermostat example

Table 2: Suitability of design patterns for UAV and a Learning Thermostat

	UAV		**Learning Thermostat**	
Design Pattern	**Res.**	**Comm.**	**Sec.**	**Comm.**
Half call		S		VS
Manager		VS		VS
Resource Manager	VS			
Message Factory & Message Interface		S		-
Publish-Subscribe		VS		S
Hierarchical State Machine		VS		-
State Machine Inheritance		S		-
Collector State		VS		S
Parallel Wait State		VS		S
Serial Wait State		-		NS
Serial Port		-		NS
High Speed Serial Port		S		-
Hardware Device	VS			
Synchronizer		VS		-
Transmit Protocol Handler		S		-
Receive Protocol Handler		S		-
Protocol Packet		VS		S
Protocol Layer		VS		-
Protocol Stack		VS	S	
Processor Architecture	VS			
Processor Architecture II	VS			
Feature Coordination		VS		-
Task Design		VS		VS
Resource allocation	VS			
Timer Management		VS		S
C++ Header File Include		S		-
STL	VS			S
STL II	VS			S

Abbreviations:
Res. – Resource Utilization
Comm. – Communication
Sec. – Security

6 CONCLUSIONS

Design of real-time systems is hard. It was hard even before the emergence of connected devices via Internet and it is becoming harder still (IoT). The complexity of IoT lies in the fact that connected devices are very diverse. These connected devices are of varying sizes, utilize different connection protocols, are either simple (sensors) or complex (actuators) yet they must all connect and perform some action in real time. Real-time systems of today are a network of different devices with different memory and processing power requirements as well as functionality. Therefore it is essential that the best practices be used in designing such systems from the onset on. These best practices are the design patterns. Their ever increasing number can assure us that we will find an adequate pattern for a specific QoS parameter – that is their greatest strength and their weakness. Either by being too dispersed in various pattern catalogues or too strictly (or generally) defined we can omit using them when appropriate. This can lead to unwanted system behavior, bad design, inability to modify and scale the design when necessary and project or cost overruns. We believe that by uniting various design pattern catalogues and keeping the classification of design patterns at the most suitable level (type of real-time system, typical QoS parameters) one can be ready from the offset with a good amount of design patterns and thus having a basic understanding and inclination of how the real-time system under design will be structured, designed and deployed.

7 FURTHER WORK

Further steps to be undertaken in light of the concepts presented in this paper is to find out other basic QoS parameters of different types of real-time systems and using these to create a larger catalogue (e.g. uniting design pattern catalogues [5, 6, 7, 8]) by classifying them via the discovered QoS parameters.

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KNOW-HOW AND AWARENESS OF OPEN DATA IN COMPANIES AND MUNICIPALITIES

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ABSTRACT

Open data has been raised as an internationally significant target for development in countries and their companies as well as in municipalities. In particular, the United States and United Kingdom and also the European Union have been investing in the development of open data. This topic is relevant when planning new business and innovative services. Opened data enable i.e. companies to use the same data sets, reducing overlapping work.

This article deals with a questionnaire study carried out in the west of Finland in the Satakunta region. The aim was to clarify at a concrete level the awareness, experiences, challenges, business possibilities, wishes and information needs of companies and municipalities for open data. The study was based on the open data project, Avaras, where the aim was to find out the reality and guide the focus of the project. The hypothesis was that the interviewees already knew the concepts of open data quite well but did not really use it yet. In reality, knowledge of open data remained quite small, but on the other hand the issue was seen to be an important development target in the near future.

1 INTRODUCTION

There are many reasons to examine open data. The concept of open data is a new outline in which the leaders of the G8 countries, in particular, want to invest. These leaders have agreed on five principles: open data by default, quality and quantity, useable by all, releasing data for improved governance, and releasing data for innovation. [7] Open data is expected to have at least the following advantages [3, 4, 5, 7, 1]: new jobs, new companies, new services and products, improved innovations, improved governance, more efficient use of the information, and raising democracy. In addition to the above advantages, Koski [2] has estimated that the turnover of Finnish companies would increase by 15% if public information were opened up.

In spite of several sources and in spite of their listed advantages it seems that it is still without stating the actual advantages scientifically. The similar situation seemed to be in the open Finland 2014 –seminar [11], in which many performers talked about the advantages of open data, but at the same time success stories were searched for in the seminar.

In this study the open data is understood as Open Knowledge Foundation [10] uses it in the practical work. The data is open data when data exists and it's digital, publicly available, free of charge, online, machine readable, available in bulk, openly licensed, and up-to-date. (i.e. [8], [9])

This paper concentrates on determining the current situation of companies and municipalities regarding open data in western Finland in the Satakunta region. The results of the study also guide the focus of the Avaras project through which this study has been made.

The structure of this paper is as follows. The research approach section (2) introduces the background to the research. The next section (3) lists and describes the aims of the questions and groups of questions. The next section (4) introduces the results and their analysis. The last section (5) is reserved for conclusions and future research ideas.

2 RESEARCH APPROACH

The questionnaire study focused on ICT companies and municipalities. The interviewees were chosen on the basis of their position; people who make major decisions on matters to which might be open data relate. The interviewees included, for example, a director of information management and municipal directors. The questionnaire study was carried out through e-mail, including a link to the actual questionnaire. The target companies numbered 86 and the target municipalities were 81 altogether. Answers from the companies totaled 27 and from the municipalities 17. The answer percentage of the whole study was about 26, which is quite a good response percentage in online questionnaire studies.

The overall goal of the Avaras project is to provide software companies with information on how to apply open data sources in their business. The project is expected to answer the following three guiding questions: (1) what kind of business opportunities do open data offer, (2) what sort of open data sources exist, and (3) how can open data be utilized technically? This questionnaire was planned and executed to answer the first guiding question. The Avaras project is funded by the City of Pori and the European Regional Development fund through the ELYcenter (Center for Economic Development, Transport and the Environment).

The same kind of questionnaire study has been conducted in Finnish at Kiuru et al. [6]. It was sent by e-mail nationwide to 30 000 targets although the final number of responses was only 531. This included 16 companies from the Satakunta region. The municipalities were not considered a target. Consequently, there was a need to update the local situation and expand the survey to include municipalities.

3 QUESTIONS AND GROUPS

The questionnaire study included major questions about open data to get a wide view of the open data situation in companies and municipalities. The number of questions was limited to about ten to avoid a fall in response rates. In the wording of the questions, the terminology of the business world was emphasized a little in spite of the fact that the study had also been directed to municipalities. However, the terminology was such that it was also comprehensible and utilized easily in the public sector. The order of the questions was caused by the objectives of the project which targeted business in particular. During the project it has been noticed, however, that the municipalities play a significant role as producers of open data.

The questions were divided into four groups. The first group focused on general awareness and use of open data. The second group focused on business opportunities and related wishes. The third group focused on the use of open data applications and wishes. The last group focused on the information needs for open data.

Question	a) Awareness	b) Experiences	c) Challenges	d) Possibilities	e) Wishes	f) Information needs	Scale
Q1	x						1-5 and don't know
Q2	->	x					no, yes, don't know
Q2,Q3	->	->	x				no, yes, don't know
Q4	->	->	->	x			1-5 and don't know
Q4	->	->	->	x		x	1-5 and don't know
Q5	->	->	->	->	x		open answers
Q6	->	->	->	->	x		1-5 and don't know
Q7		x					no, yes, don't know
Q8					x		open answers
Q9						x	open answers
Q10						x	open answers

Table 1. *Focus areas and scale of questions.*

The above table describes the focus areas of the questions and their real aims. It also expresses how these questions are inter-linked. The arrows in the table describe the information needed to achieve the next phase. For example, in question Q2 you need to be aware of open data before you can experience it. The scale is from 1 (no) to 5 (yes), with the other numbers between or don't know.

3.1 Awareness, experiences and challenges

The first (Q1) set of questions ascertains the interviewee's general knowledge of the terms and actors in the field of ICT and open data. The second set of (Q2) question clarifies the interviewee's experiences of open data use in business. The last sub question of the (Q2) second question set and third question clarify the kind of challenges the interviewee has faced. After all, if the interviewee has awareness and experiences so then they may well have also met challenges.

(Q1) How well do you know the following? (open data, open data sets, Helsinki Region Infoshare, public sector ICT functions (JulkICT), Open data Tampere Region, Apps4Finland, open data catalogues, open Knowledge foundation of Finland)

(Q2) Your experience of the use of the open data from your company:

- Do you use a set of open data? If yes, what?
- Has the use of open data been integrated into your systems?
- Have you opened up data for the use of others?
- Have you met obstacles in utilizing open data?

(Q3) If you have met challenges which are related to open data, what kind were they?

3.2 Business opportunities and needs

The fourth set of questions (Q4) ascertains the interviewee's views of the possibilities of doing business with open data. If there are good answers to questions Q1-Q3, then there should be better perception of the possibilities. Question four also contains a specific sub-question of whether more information is needed. The fifth (Q5) question clarifies the interviewee's need to obtain specific open data which would help their business. It is easier for the interviewee to estimate and answer if the responses to questions Q1-Q4 are high. The sixth (Q6) question studies the interviewee's need to have an open data catalog in Satakunta. This question also requires the preceding information so that the need for this can be estimated properly.

(Q4) Open data business opportunities

- Do you see business opportunities in open data?
- Do you feel that open data is ready for business exploitation?
- Is there enough information in open data?

(Q5) The opening up of what kind of information would help your business?

(Q6) Open data sets and catalogue in the Satakunta region is needed?

3.3 Applications

The seventh (Q7) question clarifies the interviewee's experiences of the applications of open data. The interviewee has not necessarily been aware that the application was based on open data. The eighth (Q8) question ascertains the interviewee's wishes for open data applications. The presentation of the wish does not require wider information about open data but would, of course, improve the presentation of the wish.

(Q7) Have you used applications which utilize open data? (Includes list of applications).
(Q8) What kind of open data applications would you hope for in the region of Satakunta?

3.4 Information needs

The ninth (Q9) question studies the interviewee's need for information generally from open data. The final, tenth (Q10) question, has been left empty for contact information to get more information about the subject of open data. Both questions are connected to access to information.

(Q9) What kind of information about open data would you like more of?
(Q10) Leave your specific contact information if you would like to be contacted about the subject of open data.

4 RESULTS OF RESPONSES

In the following table, all the answers are in compressed form. The sections which are emphasized in each question have been mentioned in the answers.

	Results by higest values
Q1	(1) 51%, (2) 17% , (3) 15%
Q2	(no) 71%
Q2,Q3	(no) 39%, don't know 39%
Q4	don't know 30%, (3-5) 59%
Q4	(1-3) 70%
Q5	Four categories
Q6	(4-5) 75%
Q7	everybody had used something
Q8	i.e. company register
Q9	i.e. business uses
Q10	

Table 2. *Results of study.*

Next, the objective of each individual question in their group are described and the received answers are analyzed.

In the first (Q1) question, the interviewees knew the terms open data and data sets, but instead on a deeper level were not known actors who are connected with the subject in Finland. The next question (Q2), 71 percent of the interviewees said 'no' to utilizing open data. 39% of the answers did not meet challenges. On the other hand, usage of open data were low thus there should not have experiences and known challenges. Maybe that is why 39% had answered 'don't know'. The interviewees listed in the third (Q3) open field question posed many different challenges, such as connected to technical rights or the quality of the data, to challenges which are related to the reliability or the availability. No individual problem was arisen past.
In the question (Q4), the open data subject is especially seen to be very important and 59% has valued it on a scale from 3-5. 30% of the interviewees had also answered that they 'don't know'. Furthermore, as many as 70% of the interviewees estimated on a scale from 1-3 that they do not have yet enough information about the subject. In the question five (Q5), there were a lot of wishes for data, which can be classified into four different categories. The different subjects hoped for were food, dogs, trade, company, addresses or the icd10 registers. Weather-related data sets were hoped for second. The opening up of standards was hoped for as the third matter. The calculations made by a country were hoped for as the fourth one. In question six (Q6), 75% of the interviewees valued on a scale of 4-5 that they hope for a data set catalog in the open data of the Satakunta region.
All the interviewees, in question (Q7), had used an application which is related to open data, and emphasized the most weather services and map materials. In question (Q8), the applications wished for were mainly public transport, company registers and connected with transactions.
Many interviewees hoped, in question (Q9), for information about the interfaces on which information had been produced on the Avaras project. More information about the business possibilities, about the statistical data, licenses to use open data, implementation made by others was also hoped for. Furthermore, practical information about the introduction and use of the data was hoped for. In question (Q10), many of interviewees had left contact information to obtain more information.

5 CONCLUSION

This paper concentrated on ascertaining the real situation of open data in companies and municipalities in the Satakunta region of Finland. The aims were to clarify the knowledge of the open data and use and what kinds of new business opportunities there are in the area. This study also guided the focuses of the Avaras project in which this questionnaire study has been made. In the study, open data was asked about in a wide perspective because earlier information was not largely available and there was no information in which direction the project would be guided. Because of the wide perspective of the study, a very in-depth picture was not obtained from any certain section, but however it was possible to use it to direct the operation of the project.
In the answers it came up that the knowledge of the open data was even surprisingly weak. In the starting point of the

study, it was hypothsized that the interviewees knew the concepts of the open data quite well already, but did not really use it yet. The fact that a municipality did not know about the subject well was also surprising even though the Finnish State has given instructions about the transition to open data. The fact that the interviewees considered the subject according was extremely positive, potential and thus necessary. This proved that the Avaras project is necessary in the area and its operation must be monitored for the compressing of information and for transmitting the open data.

The little difference between the municipalities and the companies came out in the first question. The knowledge of municipalities was a little worse than that of the companies. In any case, both need more knowledge about open data.

The result of the study at Kiuru et al. [6] was that the companies would invest in the improvement of their products and their services or in diversifying them or would develop, and renew if the public information were opened. Furthermore, the significance of the sources of information would be significant in the innovation, to materialize the idea and development. This study and Kiuru et al. [6] study support each other. The study of Kiuru et al. was on a national level and this study was local, but was expanded to also include municipalities. In the first phase, the municipalities have a big role in the opening of data. This study and the Kiuru et al. study found that there are big opportunities for companies but in this study it was found out that the same applies to municipalities too.

Consequently, the Avaras project has a significant role in bringing to the business world examples of using open data and awakening the knowledge of open data in companies an municipalities. In this way, they can see more clearly their own business development and innovation opportunities. There is the need to get out the executed techniques where the technical challenges have been overcome and to the openers of the open data, emphasizing the usability of the open data; in other words, the data are of high quality, reliable, always in the outstanding and genuinely open.

The Avaras project should continue research to find the real business advantages of open data and find scientific justifications for the advantages of the open data.

In the future, it is to be examined whether companies and municipalities also would find their role in the value chain of the open data. At the moment, the real business possibilities are, however, are still unclear. There is also the need for a direct examination of the analysis of an open data set, including big data concepts. It seems that many of the projects which function in Finland are collecting opening wishes. Data wishes would seem to be one part of the development of open data. In other words, it is attempted to go in an order of wishes. These kinds of activities should be thought of if there is a follow-up project after the Avaras project.

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MODELING ORGANIZATIONAL COMMUNICATION WITH EXTENDED CONVERSATION DIAGRAMS

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ABSTRACT

Following the introduction of BPMN 2.0 Conversation diagrams, business modelers aquired a standardized notation for the representation of intra- and inter-organizational communincation. However, an analysis of the notation and its instances shows that conversation diagrams are primarily useful for representing high-level interactions between collaborating parties and process landscapes. On the other hand, it is difficult to model complex communication processes which appear between stakeholders within real organizational settings and virtual communities and are entirely based on e-communication. These have highlighted an opportunity for extending the notation to make it more applicable and useful, which is presented in this article.

1 INTRODUCTION

Communication represents the exchange of messages and information among people and is therefore an essential human activity. It is also pervasive within an organizational environment, where it represents the process by which individuals stimulate meanings in the minds of other individuals by means of verbal and non-verbal messages [1]. Organizational communication serves six essential functions within organizations which are: informing, regulating, integrating, managing, persuading, and socializing [2].

The way people communicate has changed dramatically since they began to interact through the internet [3]. Additionally, with the emergence of the second generation of the Web (Web 2.0) the amount, the method and the communication tools have once again evolved significantly and this has thus affected organizational communication.

As with any other type of organizational process, the communication processes have a great impact on the effectiveness and efficiency of an organization. However, while the internal workflows and collaborative processes can be well-managed with business process management tehniques and tools, communication processes commonly lack them. As a result, the communication tools are often used inconsistently, reduntantly and non-sistematically throughout an organization where the communication paths are unclear. These can be partially addressed with Unified Communication (UC), which, in short, bridges the gap between VoIP and other computer-related communication technologies. However UC is an architecture and does not address communication processes, techniques or methods. A lack of proper communication techniques is also evident within the field of process modeling. Workflows and collaboration processes can be clearly defined with Business Process Model and Notation (BPMN) where, on the other hand, communication processes are well represented only on lower communication layers, i.e. in forms of a networking architecture; this usually shows networking nodes and communication paths between them. In this case UML deployment diagrams can be used, usually with some extra networking stereotypes (Figure 1).

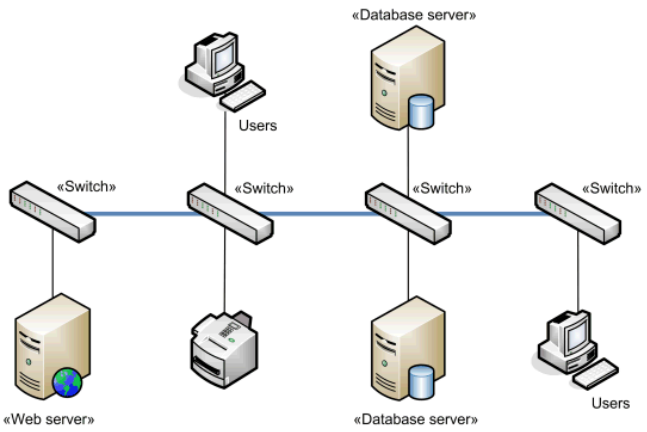

Figure 1: *UML deployment diagram with networking stereotypes*

However, networking diagrams cannot represent the applicative (i.e. end-user) layer of communicating processes (e.g. which type of communicating tools should be used during specific communicative processes).This layer of communication process modeling was has been partially addressed with the latest release of BPMN 2.0, with the introduction of Conversation diagrams, as presented below.

2 BPMN 2.0 CONVERSATION DIAGRAMS

Conversation diagrams (Figure 2) represent a top-level view of BPMN collaboration diagrams and are useful for representing process landscapes and high-level interactions between involved parties - i.e. for representing an overview of a network of partners and how they communicate with each other.

Conversation diagrams' notation consist of seven visual elements only. Two elements represent different participants (rectangles) where four elements are conversation node elements (hexagons). The participant is representative of a BPMN pool and thus represents people, organizations or devices which are involved in a specific communication. Conversation node elements are graphically represented as hexagons and define communications between two or more participants. Semantically a conversation element can be expanded into a series of message flows between participants. In the case a conversation element having the symbol "+", it represents a sub-conversation which can be expanded into a series of message flows as well as conversations. This is similar to a sub-process in a business process diagram. Additionally, two reusable conversation node elements are defined: global conversation and collaboration, both represented as hexagons with thick borders. Global conversation reuses the attributes and properties of other instances of diagrams, where the collaboration element can be called upon by other collaboration diagrams [4, 5].

The above elements are interconnected with conversation links. A conversation link is graphically represented with a solid double line, and always connects conversation node elements with participants, where it is not allowed to connect two of the same types of elements [5].

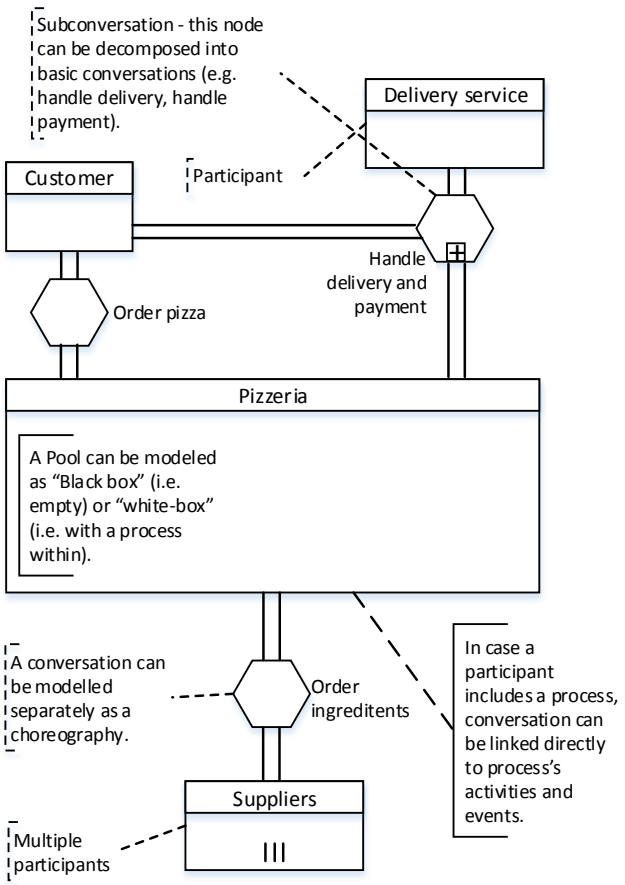

Figure 2: *Conversation diagram representing pizza reustaurant processes*

As evident from Figure 2, a conversation diagram consists of a small number of unique symbols which makes it quickly learnable and easy to understand. On the other hand, it lacks those elements which would be necessary to model complex communication, as appears in real organizational settings, including differect types of e-communication. These limitations have highlighed an opportunity for extending the notation to make it more applicable and useful.

3 PROPOSED EXTENSIONS

The main objective of extending conversation diagrams was to define additional elements for representing organizational communications like e-communication and SOA (Service Oriented Architecture), which has been perceived as a weakness in related studies [6]. In order to ensure ease of use and usefulness of the proposed extensions, we searched for similar ideas within other notations and related fields, e.g. UML, ARIS EPC and theory of databases. We have also incorporated the recommendations for designing new graphical notations, as proposed by Moody [7]. By considering these, we identified 15 new elements, which are summarized in the following Table (Table 1).

Table 1: *Extended set of elements*

Element name	Description	Examples	Primary notation
Participant - Person	Type of participant is a person or group of people.	Participant in conversation is an engineer, a doctor, etc.	UML Use case, BPMN
Participant - Organization	Type of participant is an organization.	Participant in conversation is a computer, a company, a bank, etc.	UML Use case, EPC
Participant – Device	Type of participant is a device.	Participant in conversation is a computer, a smart phone, etc.	UML Use case, BPMN
Participant rule	Participants must comply with the defined rules, written in a comment.	Participant 'Engineer' must have a Java license.	BPMN
Background conversation	Navigation element that points to the separate model of organization conversation.	We are interested in the communication within the company. So, we present organization conversation on a separate model.	EPC
Conversation rule	Conversation must comply with the defined rules, written in	Conversation takes places in the CEO's office.	BPMN

Element name	Description	Examples	Primary notation
	a comment.		
Complex conversation	Conversation between three or more participants, where details of conversation are not important.	Supplier, dealer and company have complex conversation.	BPMN
Navigation	Navigation elements that points to the separate model of a conversation.	Conversation is to complex to be modeled on the same model.	BPMN
Sequence conversation	Specifies the order of message flows.	Order of messages when asking for a credit is same in any case.	UML Sequence diagram, BPMN 2.0
One way conversation	Same direction of messages.	Weather sensor is sending data to the server.	SOA
Two way conversation	Every message is in different direction than the last one.	Servers are exchanging processed data.	SOA
Push conversation	The first and the last message is in the same direction, where the remaining messages' directions are reversed.	RSS, e-mail newsletters, live scores, etc.	SOA
Events	Events begin, terminate or end conversation.	E-mail, received from a bank, starts the conversation.	BPMN
Generalization	A participant inherits the rights from another participant.	CEO has the same rights as an engineer. Additionally he can arrange new business.	UML Use case
Extend	Optional possibility to start other Conversation elements.	Successful completion of negotiations can start a new conversation about new jobs.	UML Use case

The graphical representation of the extended set of elements is summarized in the following figure (Figure 3).

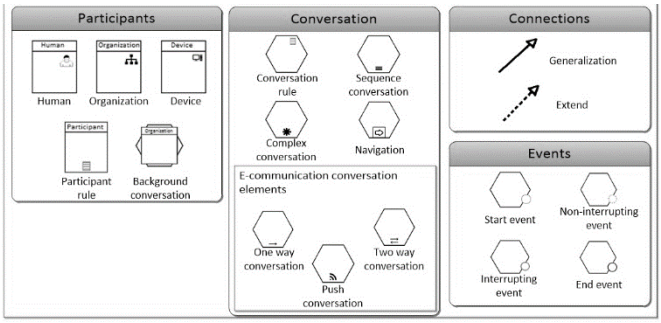

Figure 3: *Graphical symbols of the proposed extensions*

In line with Popper's three worlds [14], each new element was defined on three abstract levels. On the conceptual level, which is suitable for modelers who create diagrams, graphical symbols for the proposed semantic elements were defined. The logical level is intended for advanced users and also for computer recognition. On this level, the new elements are semantically represented with basic BPMN 2.0 elements (i.e. exchange of message flows) and the corresponding attributes. The physical level, which is dedicated to computer devices, defined new elements in XML format according to the extended BPMN meta-model. An example element on all three levels is presented below.

4. PUSH CONVERSATION ELEMENT

The Push conversation element has been introduced since this type of conversation is common in SOA and e-communication. The Push conversation element represents push technologies, like RSS, live score website concept, instant messaging, mail newsletters, etc. Since Push conversation is commonly implemented within RSS technology, the visual representation of the element was obtained from RSS (Figure 3).

Figure 3: *Push conversation element – graphical representation (conceptual level)*

On the logical level, the Push conversation element is represented by a series of message flows (figure 4). In the case of Push conversation, the directions of messages between two devices is also important. The first and last message go in the same direction, whereas the remaining messages' directions are reversed.

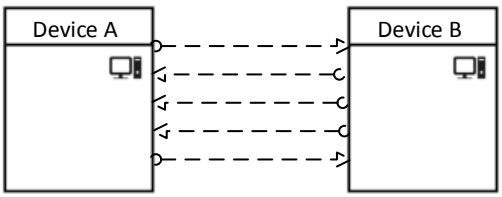

Figure 4: *Push conversation element (logical level)*

The Push conversation element also has the following required attributes (Table 2):

Table 2: *Push conversation elements attributes*

Attribute name	Description
participantRefs: Participant [2…*], [Device]	The types of participants, which are connected to Push conversation, have to be devices.

The physical level of the Push conversation element is readable for devices and is therefore defined in XML format. XML has to be consistent with the following XML Schema Definition (XSD) of the Push conversation element.

```
<xsd:element name="pushConversation"
type="tConversationNode"/>
<xsd:complexType name="tConversationNode">
<xsd:complexContent>
       <xsd:extension base="tBaseElement">
              <xsd:sequence>
              <xsd:element
       name="messageFlowRef" type="xsd:QName"
       minOccurs="0" maxOccurs="unbounded"/>
              <xsd:element
       name="participantRef" type="xsd:QName"
       minOccurs="0" maxOccurs="unbounded"
       fixed="Device"/>
              <xsd:lement
       name="boundaryEventRefs"
       type="xsd:QName" minOccurs="0"
       maxOccurs="1"/>
              </xsd:sequence>
              <xsd:attribute
              name="conversationRef"
              type="xsd:QName"/>
              <xsd:attribute
              name="correlationKeyRef"
              type="xsd:QName"/>
              <xsd:attribute
       name="extendFlowRefs" type="xsd:QName"
       use="optional"/>
              </xsd:extension>
       </xsd:complexContent>
</xsd:complexType>
```

The above XSD consists of references from message flows, participant, boundary, conversation, correlation key and extend flow, which is optional. References are links to XSD Schemas of BPMN standard and our newly built XSDs.

The next figure represents an example of a Push conversation element. This element must be connected to two or more devices (e.g. server and tablet computer). Other types of participants, like an organization or person are not allowed to connect with a push conversation element.

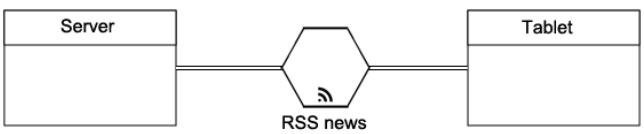

Figure 5: *Push conversation example*

Push conversation element could present communicating technologies like RSS, instant messaging, etc.

6 CONCLUSION

Conversation diagrams, which were introduced in BPMN 2.0, are primarily used for modeling 'process landscapes' and basic interactions between different process participants. With an additional 15 elements, which were introduced from our research, we have adapted Conversation diagrams for modeling organizational communication which is nowadays supported by different types of e-communication tools and services. These new elements are defined on three levels: conceptual, logical and physical, including an extended meta-model and serialization of all elements.

Preliminarily, the diagrams based on new elements were compared with standardized notation based ones. This evaluation was performed by first-year IT students, who were unaware of Conversation diagrams and their extensions and therefore offered a suitable population for identifying benefits and weaknesses on both notations. Students perceived the existing notation as being faster for modeling and less-error prone, mostly due to its simplicity. The extended notation was perceived as more comprehensible and suitable for modeling complex situations.

Based on these preliminary results, we want to continue with our research into improving the extended notation and afterwards to experimentally investigate whether modelers would accept the proposed extensions to conversation diagrams.

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CRITICAL SUCCESS FACTORS OF AGILE SOFTWARE DEVELOPMENT

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ABSTRACT

Agile software development refers to a group of methods that deal with issues associated with today's software development. This paper presents their critical success factors (CSFs). CSFs can help practitioners and interested readers further understand and compare the suitability of agile methods for their specific needs. The results of a systematic literature review provided us with a set of potential factors that impact the success of agile projects. The results of the SLR were also verified by a survey conducted at a local level. The final results of the systematic literature review and conducted survey pointed to five critical success factors in agile software development. These are: good communication between team members, organizational culture, customer collaboration, team capability, and training and learning.

1 INTRODUCTION

Agile methods currently represent one of the most popular and effective approaches to software development as a response to the classical approach of software development, which is based on stable and predictable projects. The basic characteristics of agile methods are:

- Development in short cycles (with frequent releases)
- Close cooperation (of the development team) with the client
- Ease of use (basic principles that can be relatively quickly learned).

A lack of knowledge about agile methods constitutes a hindrance for those who wish to introduce them into their environment. This is true especially for people who are only well acquainted with traditional methods of software development and are struggling to switch their process to agile methods. The aim of this paper is to improve the understanding of agile methods and to identify the key factors that affect their usage. We identify and provide insight into critical success factors that enhance the success of software development projects using agile methods. These key success factors also indicate under what circumstances the use of agile methods make sense and why in some cases agile methods are less successful. Based on the identified factors, organizations can ease the assessment of the suitability of agile development for their environment and lower their risks when transitioning to software development using agile methods.

2 AGILE SOFTWARE DEVELOPMENT

Agile software development brings substantial changes to software development compared to traditional methods of software development. Flexibility and responsiveness in software development has never been so important. Since the era of web applications, and nowadays mobile applications, the level of competition has increased significantly. Therefore, only the development of new software and fixing bugs is not enough anymore, it is necessary to constantly follow what the market and its users need and want. With this in mind, agile software development methods are a perfect match for this kind of thinking. They represent an improved way of managing and planning projects with a greater focus on effective change management instead of following a comprehensive upfront design at the beginning of the project (typical in traditional software development methods). People and their creativity play a crucial role. So instead of following a rigorous formal processes, agile methods are based on management and collaboration, enabling informal communication and greater mutual understanding of the individuals involved.

The list of agile software development methods can vary depending on the practitioner's aspect. According to the "State of Agile Development" survey conducted by Version One in October 2013, the most used agile method is Scrum and its variants. It is used by more than 65% of respondents, many of them in combination with Extreme Programming. The agile method that has been gaining in popularity over the last few years is Kanban. The other commonly known agile methods include: Feature Driven Development, Agile Unified Process, Agile Modeling, the Dynamic Systems Development Method, and others. In the following subsections, we will briefly describe three of the most commonly used agile methods.

3 AGILE SOFTWARE DEVELOPMENT CRITICAL SUCCESS FACTORS

The concept of critical success factors was created in an effort to distinguish between critical and non-critical information on decisions in the field of business informatics. As an approach for identifying and measuring the success of

the organization they were first presented in 1979 . This first presentation of the critical success factor (CSF) approach covers a limited number of areas in which satisfactory results ensure successful competitive operation of an individual, department or organization. It represents the key areas that must function well in order to achieve business success and meet the desired goals. Currently, the CSF approach is most frequently used in the context of a project or initiative and constitutes the most important efforts to ensure success. They indicate which areas need more attention and are crucial to the successful completion of the project.

In the context of this paper, CSF are related to the factors that influence the success of agile software development projects. For the basis of our research, we selected the study from authors Chow and Cao (hereinafter: S1), since it covers a lot of potential key success factors, divided into several categories. The authors in S1 conducted a survey on the key success factors in agile software development projects. A list of critical success factors was identified based on a systematic literature review, due to the lack of systematic literature reviews on the topic of the critical success factors in agile software development. The review covered 15 studies, which identified a list of 39 critical success factors. All identified CSFs were then combined into 12 main factors, divided into five categories. After a systematic literature review, the survey was developed and conducted. The survey had 408 respondents from 109 different organizations that were using agile projects, of different sizes, and from various industries and geographic locations. After analyzing the results of the survey, only three of the 12 factors proved critical for success while three factors were critical to individual dimensions of project success.

3.1 Supplementing and extending the CSFs of agile methods

The list of critical success factors presented in the research S1 was used as the starting point of our research. When a duplicated or similar CSF was found it was marked down that multiple studies dealt with the same CSF. The same was done with newly identified CSFs. With this approach, the CSF list from S1 was supplemented and we presented which and how many studies dealt with individual factors. The studies that accepted one or more factor of agile software development as critical were also marked. In cases where multiple studies dealt with the same factor but the factor was in a different category, we decided in which category to put the factor based on the quality and number of studies that mentioned the factor under the specific category.

3.2 Systematic literature review on the CSF of agile methods

In order to extend the CSF list from research S1, a systematic literature review (hereinafter: SLR) was conducted. SLR is a means of identifying, evaluating, and interpreting all available research relevant to a particular research question, or topic area, or phenomenon of interest. Individual studies contributing to an SLR are called primary studies; an SLR is a form of secondary study. To conduct this SLR, the guidelines proposed by were used. SLR included studies from the year 2006 onwards. The results of the SLR provided us with 16 primary studies. Most of the studies were from the years 2012 and 2010 (9 out of 16) and came from New Zealand (20%) followed by Germany and the UK (13%). The studies were equally divided between conference proceedings papers and journal papers. The vast majority of studies used a survey or case study as a research method. 70% of primary studies researched the Scrum agile method, which goes in line with the "State of Agile Development" survey conducted by Version One; the same goes for XP and Scrum/XP hybrid which placed 2nd and 3rd. Each CSF extracted from primary studies was divided into one of four groups presented in S1. CSFs with similar properties were combined. CSFs that were specific to a particular agile method and were difficult or unable to generalize were left out as they were rare (they were mentioned in only one primary study).

CSFs of agile software development that were extracted from primary studies and identified as a result of SLR were presented in a fish-bone diagram (The diagram figure has been omitted due to the space limitations of this paper). Each factor was divided into one of 7 groups from S1 and two newly identified groups.

4 SURVEY STUDY ON CRITICAL SUCCESS FACTORS OF AGILE SOFTWARE DEVELOPMENT

After an SLR, we conducted a survey. With this, we wanted to verify the findings of the SLR in the local environment. During the planning of the survey we focused on defining a unique and understandable set of questions that went through several stages of reviews. To resolve any ambiguities, our pre-test survey was conducted by two developers with experience in agile methods.

The target population of the survey were local practitioners of agile methods that share their knowledge on agile methods in a LinkedIn Group named Skram.si. At the time of writing, this group contained 444 members. The survey was answered by 29 practitioners. With the result of the survey, we checked if the perception of critical success factors of agile software development differed from the results of the SLR in our local environment.

4.1 Survey study results overview and key findings

The survey stared with some typical questions asking the respondents about the type of software they were developing, their role in the team, the size of the organization, the average team size, iteration cycles, and agile method used, etc. As we are limited to a certain number of pages, we cannot discuss every question from this typical groups of factors. So we will discuss only the few of them that we believe to be most important to the reader. Most of the respondents were engaged in developing software for end users (45%) and the development of information systems (38%). 7% of respondents were developing system software, 7% commercial software, and

3% were developing custom software. Respondents also had different roles in their teams. 38% of respondents chose the option "developer/tester," followed by Team Lead with 21%, Project Manager and System Analyst with 14%. The survey also showed that the most popular agile method was Scrum. Scrum and its variants were chosen by 54% of the practitioners of agile development and 38% of the responses were for the Scrum method exclusively. Next was XP with 27%, followed by a Scrum/XP hybrid and Kanban, both with 7% (Figure **1**).

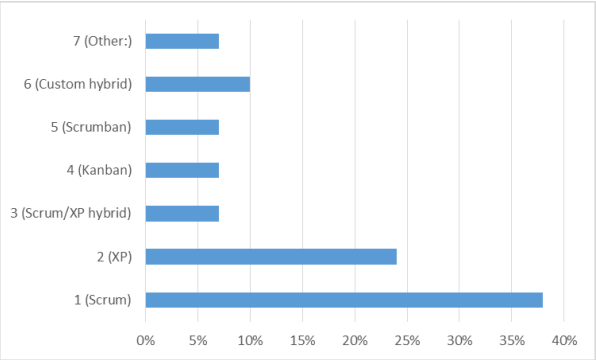

Figure 1: *Agile method used*

The responses also cover a wide range of diversity over time, when it comes to using agile software development by the respondents. Again, this question had multiple answers for each of the given options. The answers 1-3 years and more than five years of experience, dominated the results. The former was chosen by 42% of respondents, while the latter was selected by 35%. 15% of respondents had practiced agile methods between 3 and 5 years. Only 8% practiced agile methods in less than one year. Internal iterations of software development by most participants lasted two weeks, the transfer of new versions to a production environment were held once a month. Most teams had a customer every day, others had contact with a customer once a week and had a customer's representative available on a daily basis.

After general questions, to determine the captured sample of participants, questions regarding the critical success factors of agile software development followed. Respondents were asked to answer each question with a five-point Likert scale on how much they agreed that a specific factor was critical for the success of agile projects (1 stood for: "Strongly disagree", while 5 stood for: "Strongly agree"). Almost all respondents completely agreed that rapid and effective communication between team members is critical to the success of the agile project. 90% of respondents strongly agreed and 10% agreed. This leads to an average value of 4.9 in favor of the influence of good communication between team members for the success of projects (Figure **2**).

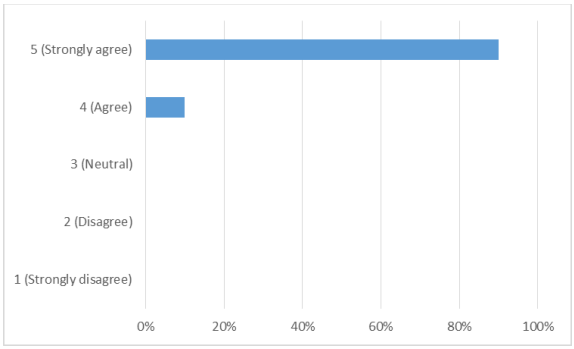

Figure 2: *Good communication between team members as a critical success factor*

The next question concerned organizational culture as a critical success factor for agile projects, with the explanation that organization should be open to changes and to support the work in a collaborative environment. 79% of the respondents strongly agreed that it is crucial for success. This question had an average value of 4.7 for answers in favor of organizational culture as a critical success factor. Most respondents also agreed that the constant training and learning of developers is critical for the success of agile projects. The final results had a mean value of 4.7. 79% of respondents strongly agreed with the question regarding the importance of the factor, 17% agreed, while 3% of respondents disagreed with the question. A similar opinion was reported with regard to customer collaboration and reached an average value of 4.6. 76% of respondents strongly agreed that customer collaboration was a critical factor for the success of agile projects. 14% agreed with the question, 7% were undecided and 3% disagreed. The results of all survey questions, related to the critical success factors of agile software development, are available in Table **1**. When considering critical success factors, there were five factors where the majority of respondents strongly agreed that they had a critical or totally positive impact on the success of the project. These were: good communication between team members, organizational culture, customer collaboration, team capability, and training and learning. These results are consistent with the critical success factors that have been confirmed in various studies included in the systematic literature review. The only factor that was not included covers the skills and competencies of team members. According to study S1, the factor includes both technical skills as well as experience, which some of the studies researched individually. Several studies confirmed the acceptance of agile methods as a critical success factor. According to S1 and other studies, this factor falls within an organizational culture that supports agile methods, so we did not specifically examine it separately. Visualization and progress tracking are not among the factors that are critical to the successful implementation of agile software development. In assessing key techniques for visualizing and tracking progress for the success of agile projects, only requirements in the form of user stories, were given a sufficiently high overall average value with respect to our above criteria.

Table 1: *Overview of question results for the critical success factors of agile projects*

Critical Success Factor	Score
Good communication between team members	4.9
Organizational culture	4.7
Constant training and learning	4.7
Team capacity	4.6
Customer collaboration	4.6
Top management support	4.5
Communication through clean code development	4.5
Team autonomy	4.4
Good communication between the team members and customer	4.3
Good communication between the team and top management	4.2
Work in a sustainable pace	4.1
Visualization and progress tracking	4.1
Team distribution	4.0
Team size	3.9

5 CONCLUSION

In this paper, we presented the results of a survey which was based on a systematic literature review of critical success factors of agile software development. The survey was conducted in a local environment and was answered by 29 respondents with different roles who have developed various types of software in organizations of various sizes. They worked mainly in teams of 5-10 members. Most of them were involved with agile methods for 1-3 years or for more than five years. 50% used Scrum or its variants. Most of them had two-week internal iterations, the product was being released to the customer, which was usually available every day, once a month.

The survey results also showed that critical success factors to agile software development in local environment are in line with the findings of the SLR. These factors are: fast and effective communication between team members; organizational culture that supports agile methods; the training and education of developers; effective customer collaboration and the qualifications and competence of team members. The management of these factors provides organizations, which are considering the implementation of agile methods or are already using them for software development, a greater chance of success in agile software development projects.

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Sodelovanje, programska oprema in storitve v informacijski družbi / Collaboration, Software and Services in Information Society

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