ISJ

Interdisciplinary Studies Journal

Special Issue on Smart Cities

Volume 3, Number 4 | 2014 | Unrefereed special issue

MEMBER OF FUAS FEDERATION OF UNIVERSITIES OF APPLIED SCIENCES

LAUREA UNIVERSITY OF APPLIED SCIENCES

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Editor-in-Chief
Tuija Hirvikoski
Laurea University of Applied Sciences
tuija.hirvikoski@laurea.fi

Tarja Laakkonen
Laurea University of Applied Sciences
isj@laurea.fi

Graphic Design
Petra Boije

ISSN 1799-2710

LAUREA UNIVERSITY OF APPLIED SCIENCES
2014

ISJ

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Foreword

Guest Editor Tuija Hirvikoski, PhD,
Director at Laurea,
European Network of Living Labs council member

With this ISJ special issue on Smart Cities Laurea, together with the European Network of LivingLabs (ENoLL), wants to support those developing their cities and regions or serving their citizens, public organizations and firms both in Europe and elsewhere. Moreover, the purpose of this ISJ number is to provide reference material for the Smart City Guidebook and extended material for the Guidebook users. The Guidebook will be published in 2014 by the World Bank and ENoLL. The contributions in this unrefereed special issue stem from both academics and practitioners in companies and public organizations both within and outside the ENoLL community.

There are many definitions of Smart Cities. "Some focus on ICT as a technology driver and enabler, while broader definitions include socio-economic, governance and multi-stakeholder aspects such as the use of social participation to enhance sustainability, quality of life and urban welfare." (Mapping Smart Cities in the EU Study, 2014) In the introductory article of this special Smart City issue, Seija Kulkki argues for the "strategic role of cities, locally and globally, in contributing to human-centric, smart, all-inclusive and sustainable growth and job creation through solving major societal challenges of our time".

Keeping in mind the mission of the Wold Bank to end extreme poverty and to promote shared prosperity we acknowledge that finding balance between different Smart City drivers in developing economies is even more difficult than in Europe. However, the Living Lab movement encourages the cities and service designers both in Europe and in developing countries to rely on human-centric approach. As there is no monopoly for innovation, the human-centric approach stresses the importance of empowering people and the significance of participation, cooperation and belonging.

We are delighted to present to you a wide range of research articles and practical papers discussing in details the Smart City phenomenon from different points of view and in different contexts: Some of the papers examine Living Labs related concepts, e.g. co-creation, user led service design, open innovation, augmented reality, eco-system business model or organizing pilots. In his article, Henrique Diz discusses the contradictory results related to Public-Private Partnership which is commonly recommended and also successfully used particularly in the field of Living Labs' related research, development and innovation activities. The strength of this paper is the way it attempts to establish the differences between successful and unsuccessful public-private partnership and the outcome of these actions in various fields of civil societies.

The research articles discuss new methods and platforms, impact evaluation and wider methodological issues with perfection. Whereas a wide range of papers introduce real life Smart Region and Smart City cases in various fields such as mobility, health and social care, wellbeing, energy, remote services, land use, real estate business and management of material and human resources.

Some of the articles epitomize how important education, learning and training programs are in boosting Smart City development. This is also the experience of Laurea University of Applied Sciences, the owner of ISJ. Laurea has a continuous nine-year tenure as a Centre of Excellence as appointed by the National Evaluation Council due to its operative model (Learning by Developing, LbD) that integrates RDI with learning and regional development. The LbD model in conjunction with the LivingLab approach is based on innovation co-creation among various stakeholders within the Helsinki Metropolitan area and on an international level. It provides Laurea graduates with great employment and start-up opportunities. Moreover, due to this successful strategic choice, Laurea orchestrates both national and international RDI operations aiming at joint value creation in the Metropolitan area.

With the help of the Lbd and LivingLab models we at Laurea are able to offer our best co-operation for our international partners and consequently access to one of the world's most competitive and advanced metropolitan areas. At Laurea, we search for world-wide co-operation with policymakers, companies and universities that have a similar aims in their regions. Together with our international partners, we aspire to construct better educational and RDI results and improve their usage in companies and within society. Through joint international RDI projects we want to provide domestic and international students with an interesting and competitive learning environment to boost their professional and academic careers.

Even though this time we were not able to attract many papers from the smart cities and actors in developing countries, we believe that in the future the European smart cities and actors will learn from their colleagues in other continents as well. For example, phenomena such as social entrepreneurship and social enterprises which are already firmly materialized in many developing countries should be studied carefully in European cities as well. This is important firstly because by bringing the experiences from social enterprises to global discursion and into collaboration with western actors, we will get an opportunity to relearn how to run our efficient organizations without forgetting the philosophical and moral reasons for our existence. Secondly, in their pursuit for economical perfection the western cities and firms might find new innovative solutions and market potential by observing how and where the less perfect social enterprises operate either in their own cities or in the developing countries. Mutual learning is already happening in Copenhagen where the CBS's Co-Creating Social entrepreneurship for Growth conference is a driving force. More events and arenas for global smart city co-creation are needed, and they will certainly appear.

Cities for Solving Societal Challenges

Towards Human-centric Socio-economic Development?

Seija Kulkki, Founding Director of the Center for Knowledge and Innovation Research (CKIR), Aalto University, Finland

Abstract

The article discusses the strategic role of cities in contributing to human-centric, smart, all-inclusive and sustainable growth and job creation through solving major societal challenges of our time. The article argues that cities may – by participating in research, development and innovation (RDI) activities for transformation of health care, energy or transportation systems or for climate action and the fight against poverty and inequality– turn out to be sources for new human-centric and sustainable socio-economic model that aims at wellbeing and quality of life. Cities may balance the shortcomings of urbanization and even 'fill the gaps' of financial market and corporate driven global economy. However, cities should have the strategic role and means to this demanding task. It is necessary to ask: who takes the initiative to solve through RDI the complex societal challenges of our time? Who defines around which challenge the RDI activities should become organized and funded? Who takes the lead?

This article argues for the strategic role of cities, locally and globally, in contributing to human-centric, smart, all-inclusive and sustainable growth and job creation through solving major societal challenges of our time. The article views that cities are places where societal challenges such as health, demographic change and wellbeing, food security, secure, clean, renewable and efficient energy, green housing, smart, green and integrated transport, inclusive, innovative and secure societies, clean air, water and climate action, resource efficiency, poverty, immigration, unemployment and many other societal problems may be met and solved. According to Katz and Bradley (2013), over half of the human population lives in cities; the estimate is that in 2050 that share is already ¾. One may assume that the massive move of people to cities for better lives makes the societal problems even more severe. The role of cities and city regions becomes even more strategic. This article argues that cities may – by adopting the policy of focusing on solving societal challenges of our time – turn out to be sources for new social and economic dynamism that balances the shortcomings of urbanization and even 'fills the gaps' of financial market and corporate driven global economy. Cities may – over years to come – create the foundations towards human-centric and sustainable socio-economic model which aims at wellbeing and quality of life (Hämäläinen 2013).

Katz and Bradley (2013) define that the city is not only about buildings and other physical structures, transit systems and streets, energy and communication infrastructures or forms of local decision making and administration. They view that a city goes beyond human-made structures; cities are rather about the quality of the ideas that they generate, innovations they spur, and opportunities they create for people living within and outside the city limits. Cities are perceived as broader economic, environmental, and infrastructure networks of the entire region of which the city is a part (Katz and Bradley, 2013). Furthermore, cities are not only local; they are part of global economic, environmental and infrastructure networks (Scott, 2001). Cities are networks of local and global life.

This article discusses cities as knowledge and innovation networks that may have a major impact on the future quality of human life and the nature. That is why Katz and Bradley (2013) argue that the cities and metropolitan areas should have the role and the means even to fix the 'broken policies' of other players such as politics of nation states or the activities of global and local firms; i.e. Katz and Bradley argue for a stronger role for cities even in fixing fragile economies. Cities may have a fundamental role in creating the foundations of knowledge and innovation based social, institutional and economic dynamism, locally and globally. We propose that the 'fixing of policies and fragile economies' may take place through RDI (research, development and innovation) activities around societal challenges. This is an activity that may bring about even new services, firms, social enterprising and lead to the reforming of industries or the creation of new ones. This activity may also bring about new technologies and new integration principles of technologies. The RDI around major societal challenges of our time may lead to social, institutional, structural and systemic innovations that are transformative by nature and may relate to human, economic and social foundations of life.

Should cities drive for solving societal challenges?

Why should we further activate cities to take a bigger role in fixing our societies and economies? In recent years, there has been a market and innovation failure by big corporations in tackling the major societal challenges – or opportunities – alone. Porter and Kramer (2011) argue even that the capitalist system is under siege; the business increasingly has been viewed as a major cause of social, environmental and economic problems in the world. Companies are widely perceived to be prospering at the expense of the broader community. They are blamed for society's failures. Porter and Kramer (2011) further argue, that the problem is an outdated approach of firms to value creation; it is viewed narrowly, optimizing short-term financial performance while missing the most important customer needs and ignoring the broader influences that determine the long-term success. However, Porter and Kramer (2011) want to balance this tendency; firms should enter into shared value creation that involves creating economic value in a way that also creates value for society by addressing its needs and challenges. They see that today there is a cliff between economic and social development due to presumed trade-offs between economic efficiency and social progress.

Scott and Davis (2007) view that firms are best positioned for efficient problem solving and innovation. Firms operate as 'long-lasting' missions or 'projects' deploying strategies, structures, processes and practices that are most purposeful and efficient to the task at hand (Scott 2001). Firms have a tendency to be very focused in their strategy definitions and emphasize the internal efficiency of their operations. We are familiar with classical 'garage' innovations made by entrepreneurial individuals or with innovations that arrive from closed university or corporate labs to open and competitive marketplace. Recently, we have learned to admire firms that experiment and pilot with customers for new service and business models (Chesbrough, 2006), or open source and social network-based innovation (Benkler, 2006) or demand and user-driven innovation (von Hippel, 2005). Von Hippel even argues for 'consumer innovations'; traditional division of labor between firms as innovators and customers is breaking down; 70% of innovations comes from markets and customers.

However, the solving of societal challenges is a RDI task around very holistic, complex, multidisciplinary and multi-stakeholder driven problems that may call for transformative joint efforts around innovations that are of social and systemic nature and deal with interconnected and complex structural, architectural or infrastructural problems beyond what we have learned until now (Kulkki, 2012). This means that we need to transform our operations around RDI beyond normal operation modes. There is a need for processes that create shared values, missions, leadership, strategies and forms of organizing that bring about better societies and quality of life. That is why we argue for collaborative strategic public-private programs or joint ventures that engage cities, public agencies, firms, funding agencies, and even people for experimentation and piloting around societal challenges. This calls for new forms of organizing, collaborative leadership, and new ways to conduct experimentative RDI – even in large scales for validity and scalability of solutions. This is also a challenge to the research and design methodologies for experimentation, prototyping and piloting. We may learn from methodological approaches of citizen science or open science.

However, this is worth of trying; the activity potentially creates better societies – and even new firms, public-private joint ventures, RDI consortiums, social enterprising, and open society-based dynamism for shared value creation.

Cities offer a natural collaboration setting for solving societal challenges; they are about a multitude of players, knowledge and competence and ways to organize for new initiatives and problem solving. They are networks of people, firms, universities, institutions and organizations to create new things, interact and run their daily activities. Moretti (2012) discusses even cities and city regions as specialized knowledge, competence and innovation places; he views that specialized knowledge and innovation capabilities around certain problem solving are so demanding that the related innovation, industries and consequent jobs 'self-organize' themselves around specialized cities and regions.

However, it is necessary to ask: who takes the initiative to solve through RDI the complex societal challenges of our time? Who defines around which challenge the RDI activities should become organized? Who takes the lead? Many of the societal challenges do not automatically 'land' to the mandatory domains of either cities themselves or the magnitude of players who benefit of the city as location and place. However, the RDI around societal challenges may have a major impact on the city as a knowledge and innovation network and consequently on the socio-economic dynamism that the city creates.

How do we organize for solving societal challenges?

We propose that the issues of how to organize, who are the partners to work with and how to fund the operations may be very challenge-specific. Problems of ageing population and wellbeing, climate change, intelligent traffic or energy efficiency and distributed energy networks around renewable energies need different ways to organize, fund and collaborate. However, something may be learned from generic collaborative RDI process adapted from corporate RDI.

The collaborative RDI process around societal challenges may have steps such as shared (i) *mission, vision and strategy creation* with a wide collection of ideas about future issues, problems, scenarios, including experimentation and piloting around a set of potential hypotheses and pre-concepts for solution, (ii) focused *experimentation around selected set of hypotheses and properties of pre-concepts as service or business models, or specifications for architectural or ecosystem designs*. This includes economic, environmental and social validation of new concepts with firms, public agencies, and people; this is a wide, interactive dialogue with future 'markets' of emerging innovations. This broadens the understanding about the sources of economic, social and environmental sustainability of value propositions. Furthermore, (iii) we commit partners, developer communities and people to the co-creation of features of usage and sources of economic and social scalability. This *'pre-market' prototyping, experimentation and piloting is designed to capture the new market dynamism, social dynamism and customer behavior*. Based on this, the personalized and generic functionalities of future usages of services, business models or architectures may become piloted. We may even enter to (iv) *wide-scale experimentation and piloting that brings about understanding of how to implement new solutions*; how to produce and deliver, how to organize around this new solution in order to make it an efficient operation – or a firm.

Companies such as AGC, IBM, Nokia and many others have used social media, social networks, crowdsourcing and other means of dialogue for identifying – even with millions of customers – the strategic challenges and their solutions for future development.

It is evident that the integration and engagement approaches have an impact on the whole process of collaborative RDI: from strategy to implementation. This is imperative, while the shared inquiry aims at developing answers to complex, all-inclusive questions such as: What are the new consumption and production patterns for sustainable development? How do we design cities for green growth? How do we design welfare systems that are efficient not only as a service or production system, but also from the viewpoint of 'customers' or rather human beings? How to improve traffic and transportation systems to become environmentally sustainable, economically efficient, intelligent and 'user-friendly'. Do we need to develop a distributed co-production system of energy? How do we change the energy consumption behavior of people?

However, the challenge is also to integrate the bottom-up and top-down approaches and the means of 'control and letting free'. It is also demanding to transcend beyond one's own strategies, agendas, competences and resources. Furthermore, the open and collaborative ecosystem challenges the underlying principles and practices of IPR (Intellectual Property Rights). Netherlands has created even instruments for citizen rewards (vouchers) in RDI! Collaboration is a real challenge; Olsen (1965) discusses about collective action in creation of public goods and concludes that individuals (and individual organizations) have a tendency to prioritize their own self-interest over mutual interests, missions and goals – especially in matters of economic importance. Only in cases, where the shared mission is fundamental enough, the self-interests as guiding driving forces may be subdued.

Are new institutions, organizations and funding instruments needed for?

The solving of societal challenges may call for new forms of policy and decision making, as well as organizational and funding arrangements. City of Lisbon has created a new strategic RDI activity around societal challenges that is highly prioritized. The head of the activity is positioned at the Mayors' office and he has own budget and resources. The new way to experiment and pilot with many partners and citizens has also changed the earlier process of policy making; the process is more transparent, experimentative and participative; the potential solutions for decision making are widely tested in real life. Policy makers have joined the collaborative RDI process in the field. Lisbon has used this approach among others in transformation of its problematic city districts to socially and economically attractive places to work and live. Lisbon also uses – as other places in Portugal – a participatory budget as a mechanism to encourage collaboration in solving societal challenges.
Helsinki has established an organization Forum Virium Helsinki to take care of collaborative RDI projects with firms, universities and citizens. Helsinki has also its own Innovation Fund.

European and global cities and city regions have also created collaborative RDI-networks such as EuroCities, Smart Cities and Innovative Regions. European regions work in collaboration for smart specialization.

European Network of Living Labs (ENoLL) is a European-wide collaboration platform with global reach that connects for collaborative RDI innovative and open city-based, regional, or industrial ecosystems. ENoLL has experimented through EU Framework funds in solving societal challenges among others with Smart Cities, cities that aim at improved energy efficiency in public buildings (SAVE ENERGY) and Future Internet PPP (Public-Private Partnership). SAVE ENERGY connected 6 European cities for experimenting the possibilities to increase efficiency of energy usage in public buildings. In each city, the users, administrator and other stakeholders of the public building – such as a school, city hall, and museum – where participating in the learning of the factors that have an impact on energy consumption. This was done among others through means of interactive serious gaming, sensory technology, and participative methodologies. The project had an immediate and long-term impact on energy consumption among the users of the buildings. In Future Internet PPP, the European ICT companies have collaborated with cities and public services in order to meet people's expectations to more transparent and efficient society with increasing digital social capital and participation. By joining forces the European stakeholders can develop not only novel and innovative Future Internet enabled services, but also innovative concepts of creating demand-driven innovations and collaborative innovation networks that can become a new European lead market concept in global competition.

In the EU Horizon 2020 Framework Programme for Research and Innovation for years 2014-2020, EU has allocated around 30 billion for solving societal challenges. This 3rd pillar for better societies is a new opening in framework funding; the other two more traditional pillars are: (1) science and technology and (2) corporate R&D.

From the viewpoint of cities and city regions, they may need to perceive themselves not only as local but rather as European or global players in solving societal challenges; this may mean creating ambitious international and local RDI strategies that open new RDI functions and consequent resources within the city activities. This may reposition and change local policy making, it may become more internationally oriented and collaborative and it may have long-term social, economic, environmental, infrastructure, competence, branding and other impacts. This may mean that the city renews fundamentally its economic development strategies, service production and technology strategies, strategies for creation of entrepreneurship, as well as partnering and funding strategies that relate to solving societal challenges.

Distributed leadership for shared value creation

Nonaka and Takeuchi (2011) argue for distributed leadership where wisdom is embedded in every individual and collective practice and action. They discuss cases where citizens, public agencies and firms have together saved their cities or lakes in crisis and brought them back to prosperous economic and social progress development path for future – through major structural, social, institutional, and economic transformation. The distributed leadership includes competence of grasping the essence of a problem and knowing how to draw conclusions and acting on them immediately. This is 'hands-on' leadership in touch with the reality. This also implies that we consciously act based on values such as goodness, beauty and truth; they are applied, tested and recreated together with other people in every action.

Human-centric view

Personally, I remember a strong moment of understanding the very core of human-centric approach. In an interview, the inhabitants of Arabianranta in Helsinki were asked: *why did you enter to plan and build your housing district by yourselves with the help of city, architects, constructors and other services.* What did it mean to you to participate in the whole process from the initial idea creation to the finalization of buildings; what does it mean to 'be in charge, in lead – in driving seat'? The answer was: *"I felt that I am the subject of my life.* I am not anymore an object". And furthermore, "we together learned to perceive our lives not only from the viewpoint of the problems of our individual daily lives. We learned to approach, understand and solve shared collective problems".

I felt strongly that this was an existential extension to what means to be a human being; an extension to what means being a citizen. This experience may even extend the underlying assumptions of the theory of social choice (Sen, 2009) that discusses societies as contexts that more or less determine the space for individual preferences and social choice; what preferences one can have and what kind of choices one may make in his or her life is 'given and dependent on the society we live'. In some societies that space is very limited, in others wider.

However, we have learned that people may change their social context and create new ones with wider opportunity space. This informs something very fundamental about human-centric, open and participative democracy and society (Economist 2014).

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About the Authors

D. Sc. (Econ) Seija Kulkki, the founding director of the Center for Knowledge and Innovation Research (CKIR), Aalto University (1999-2010) and the Professor of Organization and Management at Aalto University School of Business (until 2013) currently works for a book: *Knowledge and Innovation Ecosystems: A Challenge of Strategy, Structure and Action of a Firm* with Professor (Emeritus) Professor Ikujiro Nonaka from Hitotsubashi University, Tokyo, Japan. She also writes about *Methodologies of Experimentation in Social Sciences: The challenge of large-scale experimentations in real life*. In 2006, she helped the Finnish government and European Commission to initiate the European Network of Living Labs (ENoLL). This was done with a wide network of European researchers and developer communities.

Beyond Open Innovation: the Living Lab Way of ICT Innovation

Tingan Tang & Matti Hämäläinen, Aalto University, Finland

Abstract

Open innovation becomes very popular nowadays. However, how to involve users in open innovation process and unleash the potential of more real life end users is still not easy. Living Lab is the development of open innovation paradigm which combines the advantages of users and their real life contexts and provides a structure and governance for involving users. In this paper, we propose a Living Lab process model and methods taxonomy. We evaluate the proposed Living Lab model and methods taxonomy by a Living Lab elderly caring case. Finally, we discuss the implications for ICT innovation and future work.

Keywords

Open Innovation, Living Labs, ICT Innovation, User Innovation

Introduction

Four innovation paradigms have been identified in the innovation literature, namely the technology push, market pull, the combination of technology push and market pull and open innovation (Ortt & van der Duin, 2008). Open innovation paradigm is characterized by more extensive alliances, partnerships and collaborations between different partners (Chesbrough, 2003).

With the Open Innovation paradigm becoming more and more popular, companies are increasingly interested in involving users in innovation, especially in the ICT innovation and services (Greer & Lei, 2012). For example, effective, agile and trusted digital services Co-creation needs to align the formalized business genuinely on the spot, or ad-hoc, namely understanding the real needs of a customer (Li & Järveläinen, 2013). However, involving users in the innovation process is still considered to be complex (Cavaye, 1995; Hyysalo, 2003; Maiden & Hare, 1998). Many reasons concerned for this are related with the transformation and expansion of the concepts of context and user in innovation process. For example, traditional IT systems focus on supporting organizational processes and work practices. While the organizational context still prevail for the usage of ICT technologies and systems, with the popularity and pervasion of ICT technologies such as home PCs, Internet and mobile phones, ICT becomes more and more popular in private contexts as well (e.g. for supporting social contacts and interactions in people's everyday lives) (Jain, 2003; Yoo, 2010).

Users usually interact with innovation applications (e.g. products or services) in continuous frames of different contexts such as space, time, actors and artifacts as shown in Figure 1 (Yoo, 2010). Hence, the process of exploring user requirements and needs related to innovations is a complex technical, social and psychological process that is bounded to the actual contexts (Ståhlbröst, 2008).

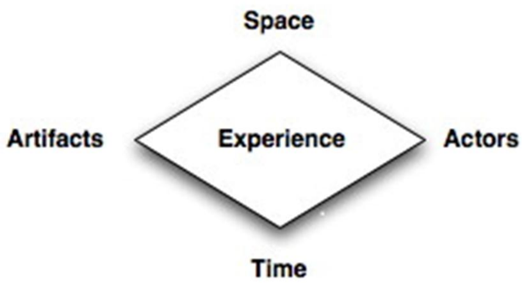

Figure 1. Schematic framework of user experience (from (Yoo, 2010))

However, many traditional user involvement approaches such as User-Centric Design (UCD) (Gulliksen et al., 2003) and Participatory Design (PD) (Muller, 2003) more come from the background of workplace context (e.g. workshop or laboratory) than users' real life contexts. Therefore, they usually have some limitations in the continuity of the interaction of different contexts (e.g. time, space, actors and events) (Friedrich, 2013). For example, traditional user involvement approaches might ignore how innovations are used with an array of other artifacts (Hasu, 2001) or neglect the collective or social aspect of innovation utilization (Flynn & Jazi, 1998; Hyysalo, 2003) or limit interaction to single events for short-term participation (Klammer, Van Den Anker, & Janneck). Therefore, recent user involvement research in innovation advocates understanding users in more mundane contexts that stretch from workplaces and organizations into everyday life (Bodker, 2009) and public spheres (Bjögvinsson, Ehn, & Hillgren, 2012).

On the other hand, the concept of users is also transformed and expanded in innovation. First, users' role has transformed and expanded during the evolution of innovation paradigm. Users' role has changed from passive content consumers to content producers (e.g. Wikipedia) to active innovation co-creators (e.g. New Product Development) (Hestad, 2009). Second, users' scope is expanded. In early period of user innovation, "Lead users", who are ahead of a trend and encounter needs, are the main source for user innovation such as open source software enthusiasts (Hippel, 1986, 1988, 2005). Many traditional user innovation examples (e.g. Open source software) stem from professional or hobbyist communities instead of average consumers (Heiskanen, Hyysalo, Kotro, & Repo, 2010). Many traditional user involvement approaches such as UCD and PD limit in involving a small group of users and are more based on the assumption that user needs are something given or pre-existing which can be answered by users or elicited by researchers. However, with the development ICT technologies, more and more ordinary people (e.g. the real end users) are empowered by ICT (e.g. PCs and Smartphones) and have the potential as new innovation source. "Lead users" based user innovation and small group of users oriented traditional user involvement approaches are not capable of addressing the needs and dreams of the majority of "normal" users (Friedrich, 2013). For average users, they articulate their needs only gradually by interacting with the applications in the real life contexts because user needs might not be well known (e.g. implicit needs) or even not yet exist at the time of involving them (e.g. future needs) (Hyysalo, 2003). They often prefer familiar products and incremental improvements (e.g. the common products in their real life contexts) (Duke, 1994; Trott, 2001). For normal users, the "user-developer culture gap" is even bigger than lead users as there are less mutual contexts between ordinary users and developers or designers (e.g. the laboratory context vs. real life social context and the unfamiliar technological solutions and modeling languages vs. familiar daily products and languages) (Vidgen, 2002).

The emergence of Living Lab innovation paradigm

Under the background of open innovation paradigm and the transformation and expansion of user and context in innovation, one emerging Open Innovation approach called "Living Lab" (LL), which employs the advantages of both real users and their real life contexts, has gained increasing interest and momentum in both industry and academic recently (E. Almirall & J. Wareham, 2009). The initial concept of LL was introduced in 1995 by Professor William Mitchell from MIT MediaLab and School of Architecture and city planning (Eriksson, Niitamo, & Kulkki, 2005). The original idea of LL was to construct a home-like living environment by ambient intelligence and ubiquitous computing technologies such as wireless and sensor technologies to sense, prototype and validate complex ICT solutions (Ståhlbröst, 2008). Examples of this kind of LLs include the Aware Home at Georgia Institute of Technology (Kidd et al., 1999) and PlaceLab at MIT (Intille et al., 2005), which simulate users' real contexts (e.g. home) in laboratory. Later, the concept has been extended to more general open innovation environments in real life contexts, in which user-driven innovation is fully integrated within the co-creation process by the close collaboration between users and other stakeholders such as business, research institutes, and government in Public-Private-People Partnerships (PPPP) (Eriksson et al., 2005). Many examples of this kind of LLs are listed in The European Network of Living Labs (ENoLL, www.openlivinglabs.eu), which transform users' real life contexts (e.g. community and city) into a big social innovation laboratory.

Living Lab as a bridge for integrating Open Innovation and Community Innovation

LL has its origin as extension to testbed for ICT technology and services. Currently, LL is also mainly used on ICT development and innovation (Følstad, 2008). The advantages and benefits of LL approach have been recognized by many studies. For example, LL can provide structure and governance for companies to involve users (E. Almirall & Wareham, 2008), understand user needs in the real life contexts (Intille et al., 2005) and reduce market-based risk (Esteve Almirall & Jonathan Wareham, 2009).

LLs have in general an important role as bridges to fill gaps. They bridge the different gaps between technology ideation and development on the one hand, and market entry and fulfillment on the other (European, 2009). LL is also a bridge or intermediary between Open Innovation and community innovation as shown in Figure 2 (Tang, Wu, Hamalainen, & Ji, 2012). On the one hand, LL provides structure and governance to user participation and other entrepreneurial support for companies (Baltes & Gard, 2010). On the other hand, LL provides company supports such as financial and technical supports to communities (Tang, Wu, Karhu, Hämäläinen, & Ji, 2012). LL functions as a link or glue for connecting different stakeholders or the Public-Private-People Partnerships.

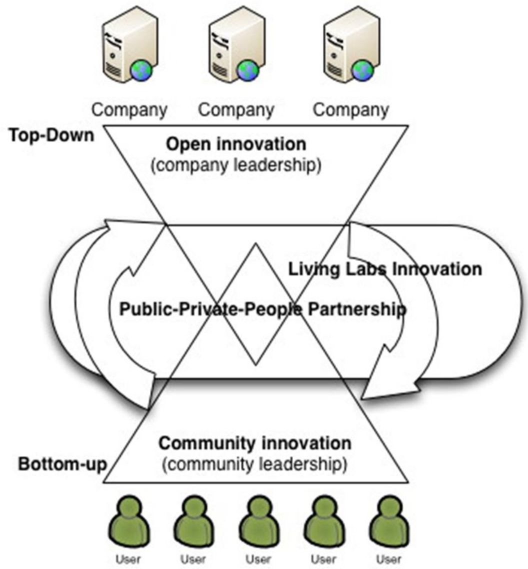

Figure 2. Living Lab as an intermediary for Open Innovation and Community innovation (from (Tang, Wu, Hamalainen, et al., 2012))

Living Lab Methodology for ICT innovation

Suitable processes and methods are needed for LL to facilitate user involvement and stakeholder collaboration in the innovation and development. However, there is a remarkable lack of in-depth descriptions and discussions of LL processes and methods in current LL literature (Følstad, 2008), especially the experiences from MacroLevel LLs) e.g. national and international LL activities) (Baltes & Gard, 2010). Therefore, we propose a LL process model and a LL methods taxonomy from many years of Sino-Finnish LL projects practice.

Living Lab process

Several LL process models on LL activities processes have been proposed in the LL literature such as FormIT model (Ståhlbröst, 2008), iLabo model, Helsinki LL model and

Catalan LL model (Esteve Almirall, Lee, & Wareham, 2012). By synthesizing the existing LL models and many years of international LL practices, we propose a LL process model as shown in Figure 3.

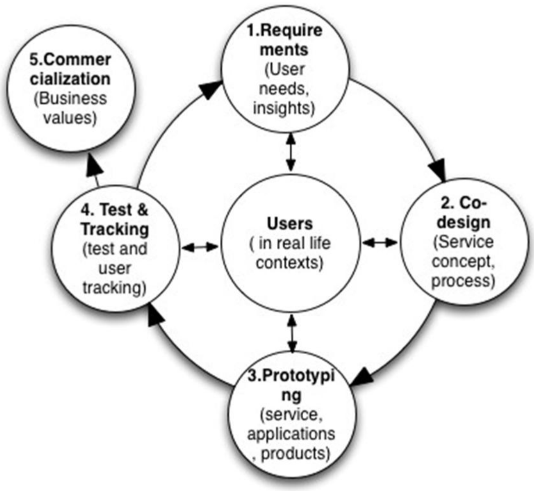

Figure 3. Living Lab process model

In this model, users and their real life contexts are in the centric positions. The model has four iterative phases: Requirements, Co-design, Prototyping and Test & Tracking plus an iteration exit phase: Commercialization.

The first phase is requirements in which the real life contexts, users (groups) and issues to be solved are preliminarily identified. For the features of LL, the issues are usually closely related with users' real life requirements and needs such as healthcare and traffic.

The second phase is co-design. Based on the input from requirement analysis phase, designers (e.g. service designers) involve users and other stakeholders to co-design some LL products or services to solve users' requirements and needs. The co-design in LL do not only deal with designers and their design processes in traditional workshop or laboratory, but also deal with how both the things undergoing design and the design process itself are simultaneously embedded in existing real life contexts and everyday life arrangements (Botero, Kommonen, & Marttila, 2010).

The third phase is prototyping. Developers co-develop LL innovation prototypes with users. The co-creation of ICT solutions is one of core advantages of LL over traditional user-centric methodologies (Mulder & Stappers, 2009).

The fourth phase is test & tracking in which the prototypes are tested (e.g. functions and usability) and users' interactions with prototypes are tracked in real life contexts (e.g. mobile handset-based user behavior monitoring). Users' feedback is collected.

All the aforementioned four phases are closely linked with users and their real life contexts. The iterative phases are not in linear sequence but can take place concurrently. Users have different roles in different phases such as co-designers and co-developers. With the innovation vortex of the iteration, some innovation outcomes might be commercialized.

Living Lab methods

LL is a mixed or multidisciplinary approach, which combines the traditional research methods and the emerging ICT-enabled research methods as shown in Figure 4. The horizontal axis is the two components of LL, namely the laboratory part (more control) and the living part (less control). The vertical axis is the mediation, by ICT or by researchers. There are four quadrants in the Figure 4, namely the ICT-embedded real context methods, ICT-adapted laboratory methods, traditional laboratory methods and traditional real context methods (Tang & Hämäläinen, 2012).

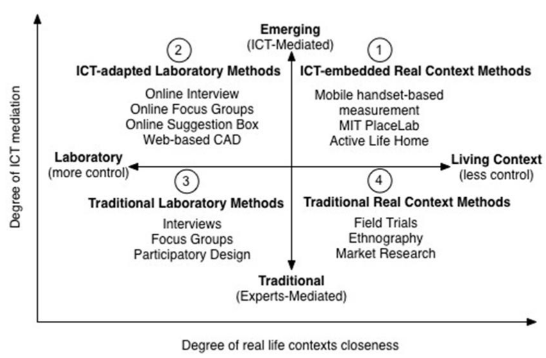

Figure 4. Living Lab methods (adapted from (Tang & Hämäläinen, 2012))

The first quadrant is the ICT-embedded real context methods. These methods are the core or essence of LL approach, which manifest the advantages and innovativeness of LL approach. Examples include the smart homes and mobile handset-based measurement. In these methods, the ICT is embedded in users' real life contexts. The advantages of the methods in this quadrant are that they are non or less obtrusive (embedded in the real life contexts) and suitable for collecting big data from large user bases continuously with less human efforts. The disadvantages include unfamiliarity to researchers and user privacy issues.

The second quadrant is the ICT-adapted laboratory methods, which are the adapted version (by ICT technologies) of traditional laboratory methods (in the third quadrant). Examples include oline interview and online focus group. Compared with the methods in the first quadrant, they are more familiar to researchers.

The third and fourth quadrants are the traditional laboratory methods (e.g. interview and survey) and traditional real context methods (e.g. field trials and ethnography) respectively. They are the well-established methods and very familiar to researchers.

Different methods have their own advantages and disadvantages in different aspects such as familiarity to researchers, obtrusiveness, data collection means, data richness and application. Depending on different LL case situations, different combinations of methods in different quadrants can be used. However, by statistics, currently a predominant use of traditional methods was observed in contrast to a rather limited usage of emerging ICT-mediated methods (Schumacher & Feurstein, 2007). The traditional methods may be well suited for some LL studies, but does not represent important methodological advances (Følstad, 2008). With the development of ICT technologies such as sensors, embedded computing and mobile computing, users' daily life activities and experiences are increasingly digitalized. There is an emerging trend for ICT-mediated methods, especially the ICT-embedded real context methods such as the smart-home type of environments like MIT PlaceLab (Intille et al., 2005) and mobile handset-based sensing and measurement methods (Verkasalo, 2009).

Case study

In this section, we present a case study in elderly caring to evaluate the proposed LL process model and methods taxonomy. The case under study is the Active Aging project, a Sino-Finnish LL collaboration project on ICT enabled aging care research.

Aging is one of the serious problems the world current faces. Smart aging is also one of the focal domains of smart city and LL research (Nam & Pardo, 2011).

In the requirements phase, different elderly user communities and contexts are selected such ash the Beijing Yangfang dian senior community and Beijing Zhanlan Road senior apartments. The requirements and needs (e.g. healthcare, emotion, travel, eating and housing) of elderly people are identified by both traditional laboratory methods such as interview and focus group in the workshops and traditional real context methods such as field trials in which researchers visit the elderly people's homes and other daily life contexts (e.g. video recording the everyday life contexts and activities of elderly people). Different types of elderly people personas are generalized for common requirements and needs.

In the co-design phase, the design processes and spaces are not only involving elderly people in the traditional workshop and laboratory but also embedded in the everyday life contexts and arrangements of elderly people. Designers co-design different services and products for solving the requirements and needs of elderly people.

In the prototyping phase, different elderly caring products (e.g. smart healthcare devices) and services (e.g. mobile applications and services) prototypes are co-created with elderly people and other stakeholders such as manufacturers and service providers.

In the test & tracking phase, the elderly caring innovation prototypes are deployed in the real life contexts of elderly people such as senior homes and used by elderly people in their daily life activities. The test and tracking are performed not only by traditional laboratory methods (e.g. usability test) but also the ICT-embedded real context methods (e.g. smart home sensors and mobile handset-based measurement). For example, user interaction behaviors are tracked by smart watch and mobile sensing. Aalto University has developed a mobile sensing application called "ContextLogger" (https://github.com/apps8os/contextlogger3), which is based on the MIT open sensing framework Funf (www.funf.org). The ContextLogger not only has all the Funf built-in sensing capabilities such as location and application usage, but also provides an interface to let users to mark or log an event such as shopping and eating. It also has the NFC (Near Field Communication) capability in which users can swipe their smartphones near the different NFC tags to log their different activities. The context-trigger questionnaire function and the integration with Smart watch will be added to ContextLogger in the near future. In this way, researchers can collect real time users' feedback in specific contexts and interpret user behaviors more easily.

During the Active Aging project, many elderly caring products and services have been commercialized and adapted and improved for different contexts and users (e.g. Finland and China).

Discussions and Conclusions

In this paper, we introduce the development of open innovation paradigm, namely the LL approach in ICT innovation. LL is a user and context driven open innovation. It's also a bridge between open innovation and community innovation, which combines the top-down and bottom-up innovation modes. LL is an innovation link for different stakeholders, namely the Public Private and People Partnerships. LL is an innovation paradigm to unleash the potential of more large scale real users in their real life contexts instead of lead users and small group of users in traditional innovation paradigms. We propose a LL process model and a LL methods taxonomy. Finally, we evaluate the proposed LL process model and methods taxonomy by a LL elderly caring case study. The key points of the proposed LL process model and methods taxonomy are as follows:

- Users and their real life contexts are in the centric positions in different phases such as user requirements and co-design. For example, in the elderly caring case, the design processes and spaces are not only involving elderly people in the traditional workshop and laboratory but also embedded in the everyday life contexts and arrangements of elderly people.
- Users take active and different roles in different phases such as co-designers and co-creators.
- LL is an umbrella concept and methodology, which combines different types of research methods such as traditional methods and ICT-enabled methods. Different methods have their own advantages and disadvantages. Different methods should be combined for better understanding user behaviors from different data sources. The ICT-embedded real context methods are the core and future trends of LL development.
- In order to unleash the innovation potential of large-scale real life users, it's important to lower the innovation participation thresholds for users (e.g. technology threshold and financial threshold). As users often prefer familiar products and incremental improvements (e.g. the common products in their real life contexts), it's important to digitalize and intelligentialize common entities in their everyday life interactions (e.g. artifacts, actors and space) by existing technologies. For example, the mobile handset-based sensing is less obtrusive for collecting user behavior data.

The proposed LL process model and methods and tools (e.g. ContextLogger) have been used in other LL domains such as smart city traffic and environment monitoring and measurement. In the future, we will improve the ContextLogger functionalities (e.g. the context-trigger questionnaire and integration with other smart sensors and devices such as Arduio-based smart devices).

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About the Authors

Tingan Tang holds MSc in engineering from the Guangdong University of Technology, China. He is a researcher and PhD candidate in the Software Business and Engineering Institute at the Aalto University School of Science, Finland..

Matti Hämäläinen holds PhD from the Department of Management Science and Information Systems, University of Texas at Austin. He is a Professor in the Software Business and Engineering Institute at the Aalto University School of Science, Finland.

Technology and Informal Care Networks: Creative Approaches to User Led Service Design for the Warm Neighbourhoods® AroundMe™ Service

Gillian Ward, Health Design & Technology Institute, Coventry University, UK,
Nikki Holliday, Health Design & Technology Institute, Coventry University, UK,
Darren Awang, Faculty of Health and Life Sciences, Coventry University, UK,
David Harson, Advanced Digital Institute, West Yorkshire, UK

Abstract

As technology develops rapidly, there is increasing attention on the use of existing technologies within better designed services to meet users' needs rather than concentrating on bespoke new technology development.

Under the dallas i-Focus programme Advanced Digital Institute (ADI), with partner HDTI, have developed the Warm Neighbourhoods® AroundMe™ service to help people live at home and enable friends and family to support them. Using existing connected home sensor technologies to detect usual daily routines, an SMS message was sent to inform them that their loved one is 'OK'.

This paper discusses the emerging service designed through co-creation with users and carers of a new, consumer-focussed assistive technology service. Workshops with older people, carers and industry representatives explored the customer journey to develop a user-led service blueprint. Participants engaged in creative design activities including visualisation, personas, and a metaphorical bus journey to map the new service.

The service was piloted over 3 months within 12 personal "neighbourhoods". The results were overwhelmingly positive. Success was due to the application of established design principles to make the service effective and desirable along with key stakeholder involvement i.e. older people and their support 'neighbourhood' to develop a simple service that fits technology into the daily lives of users. The service is now moving towards commercialisation.

Keywords

Technology, Co-creation, Living Labs, User engagement, Service design

Introduction

In the UK, telecare services have yet to be established as a mainstream option to support people to age in place in their own home. The dallas project funded by the Technology Strategy Board is a £23 million project aimed at Delivering Assisted Living Lifestyles at Scale (dallas). The programme has established four communities in the UK to show how assisted living technologies and services can be used to promote well-being, quality health and social care and enable people to live independently. dallas aims to help grow the assisted living sector and position UK companies to take advantage of increasing global demand for assisted living products and services. However there is a need to demonstrate that services can be provided at a sufficient scale and affordable cost to enable independent living. This requires thinking beyond traditional health and social care provision. As technology develops rapidly, there is increasing attention on the use of existing technologies within better designed services to meet users' needs rather than concentrating on bespoke new technology development. New spaces for innovation are emerging in terms of assisted living opportunities. One such space lies between the informal support provided by carers and neighbours to older and vulnerable people and the formal care and response approach offered by traditional social or health care monitoring systems.

One of the dallas communities, i-Focus, aims to design a new consumer focused service (outwith statutory telecare services) to support older or vulnerable people to live independently by using consumer technology to connect their families and friends to support them more easily at home.

To meet this aim of the i-Focus programme, the Advanced Digital Institute (ADI) and their partner, the Health Design & Technology Institute at Coventry University developed the Warm Neighbourhoods® AroundMe™ service through applying existing connected home sensor technologies to detect usual daily routines and SMS messaging to inform family and friends that their loved one is 'OK'.

Method

Coventry University gave ethical approval (Reference: P6212 and P7215) for the research to take place.

A primarily qualitative approach was taken to the development of the service. Using co-creation methodologies a pilot service model was designed with users, carers and assistive technology industry representatives through service design workshops. Following this a Living Lab methodology (Westerlund and Leminen, 2011) was used to test the newly developed service in situ in a winter trial.

The service design workshops were based on Sanders and Stappers (2008) co-creation model. Participants engaged in creative design activities including visualisation, personas, and a metaphorical bus journey (Stickdorn and Schneider, 2012) to map the new, consumer-focussed assistive technology service. In the winter trial, data regarding the experience of the service was collected via face to face and telephone interviews, and an event diary. Trend data for each participant was collected through the system server and used to compare with the event diary.

Service Design and Co-creation

The aim of the co-creation activities was to enable potential customers, their informal carers/family or friends and industry representatives, to engage with the i-Focus WarmNeighbourhoods® concept and provide data to aid the definition and design of the initial service blueprint.

Two co-creation workshops were held in order to explore the potential user journey through the new service from beginning to end. The first workshop included potential service customers and people who could make up part of that person's 'neighbourhood', for example, a friend, family member, or neighbour. The second workshop included industry and service representatives.

Participants were recruited via Coventry University employee networks, local charity and third sector groups such as Age UK, Coventry and local housing associations along with industry and manufacturer representatives in the assistive technology market. 12 participants took part in the first workshop, 33% were aged under 64 and 66% were over 65 years old. The group were evenly divided between those who saw themselves as the user of the service and those who defined themselves as a carer.

A key part of the new service was that it was distinguishable from other existing message and emergency type response services to focus on well being and "I'm okay" information as opposed to "I need help". The concept of what constitutes "ok" and how this might be communicated was explored through discussion about daily routines and electrical appliances used that might indicate the person was okay. Participants were asked to vote for a range of different sensors they thought were most important for inclusion in the new service. Votes were tallied and placed in a rank order of importance. Customer personas and a metaphorical bus journey were then used to explore how different people might use this new service. Discussions were had about the type of data and information they would be willing to share about themselves within an informal care setting and the customer service model was explored.

Results from the user/carer workshop were presented to the industry and manufacturer representatives in the assistive technology market to comment on the feasibility and any technical implications of the user/carer service design. Thirteen participants took part in the second workshop; this group agreed that a combination of sensors was required to give a broader picture of someone's well-being. The group also felt that design was important and the technology should look modern and appealing.

Interestingly both groups agreed that a high level of human interaction when a message was sent was important. The participants recognised that this service could focus on increasing social interaction amongst networks in comparison to statutory services where technology is often cited as reducing personal contact.

Following the co-creation and service design activities, the pilot service proposition for the winter trial was established as; door sensors, electrical consumption monitors, an ambient temperature sensor and a home hub. The sensors could detect whether a kettle or other electrical appliance that was used routinely in the morning had been switched on, a specified door, cupboard or fridge had been opened or whether the temperature in the home had fallen below an acceptable threshold. The co-intelligence or combination of these sensors indicated that the person was up and about and ok. Positive wellbeing, status and activity SMS message options were designed e.g. "I'm OK", "I'm away" or "the person is inactive" to be sent to their personal neighbourhood. The service also had to be configurable to suit different lifestyles and needs in order to fit in with normal patterns of daily life for an individual.

Purposefully, no new technology development was undertaken, rather the purpose of the winter trial was to test the service concept as opposed to developing new technology therefore repurposed telecare sensors were used and installed by an established telecare company in the UK, Tynetec.

The Living Lab – Winter trial

The purpose of this living lab was to test the service concept of linking together a range of standard telecare sensors within the user's home in order to provide relevant information to an identified neighbour and informal carer network regarding the wellbeing of the user. Each group formed a 'personal networked neighbourhood'. Using this approach the neighbourhood did not rely on an external formal response centre and the technology was not a replacement for the emergency response service provided by many telecare providers. This innovation separates this new service from existing statutory telecare models.

In order to recruit "neighbourhoods" of participants (i.e. the older or vulnerable person plus one or two informal carers) a wide recruitment strategy was undertaken using a purposive approach to target both potential users and carers. To reach informal carers information about the project was circulated to employees by the gatekeepers of; British Gas, Coventry University and Age UK and to reach potential users was circulated through; Orbit Housing Association, National Energy Action Group (Midlands branch), West Midlands Fire Service, Older People's action groups - e.g. Coventry and Age UK.

All participants, in all neighbourhoods had to give informed signed consent in order to take part in the trial. Once participants confirmed that all potential members of the neighbourhood were happy to take part, a researcher visited the main user in their home, gained informed consent, and discussed the best placement of the sensors with the user and their neighbourhood.

This type of service has a particular relevance to support people with mild dementia living at home and we cannot make the blanket assumption that a person with dementia is unable to give consent to take part in research. Therefore, the default position taken by the research team was that people with mild dementia can give consent and to seek it. Capacity to consent often depends on the situation and how the issue and information given is presented (Department of Health, 2005). This requires finding the best approach to consult with the person with dementia about the devices and services being offered. This may include using verbal and non verbal approaches such as pictures, and real examples of the technology to help explain how the system works. All of these approaches were used to inform participants about how the technology worked and what the research was about.

Informed consent was obtained from the person with dementia by the researchers following the Mental Capacity Act (MCA) (Department of Health, 2005) guidance to assess for capacity to consent. The researchers aimed to ensure that the participants with dementia could:

- Understand the information given to them
- Retain information long enough to be able to make the decision
- Weigh up the information available to make the decision
- Communicate their decision to take part in the research.

Participants who could not demonstrate the above were not able to take part in the study.
Twelve personal neighbourhoods took part in a 12 week living lab trial across the West Midlands Region of England. This consisted of 14 users and 19 carers and responders. Ages of the users ranged from 55-85 years. Three user participants from three separate neighbourhoods had dementia. Two neighbourhoods included couples as the main users as opposed to individuals. One participant died shortly after the midpoint interview, all others completed the trial period.

Results and Impacts from the Living Lab

Interview and diary data was collected from all participants over the trial period. Interviews were audio recorded and transcribed for analysis using thematic content analysis (Green and Thorogood, 2004).The following themes emerged from the analysis, participant's quotes have been used to illustrate the themes and all names have been changed to preserve anonymity;

Context for joining the trial and prior worries
The majority of users and carers stated that they chose to join the trial because they had concerns regarding the well being either of themselves or their loved ones. This included falling, living alone, general vulnerability and concerns about looking after themselves such as eating and drinking regularly. A few just wanted to take part in the research and did not have any prior concerns about well being, however, notably this group subsequently saw the value of the service within the context of their own lives and wanted to keep the equipment after the trial.

Experience overall
From taking part in the Living Lab participants experienced feelings of safety, reassurance or "peace of mind" and confidence associated with the pilot service provided. They felt that the service was 'a good idea' and no one could identify any negative points about the concept of the service.

> *"It's good for me to know that somebody is literally keeping an eye on me every day." (Phyllis, User, Neighbourhood 9)*

Neighbourhood participants felt less worried about loved ones and came to expect and anticipate daily activity text messages.

> *"I find I'm actually looking, not forwards, but I'm anticipating the text coming through." (Lois, Responder, Neighbourhood 10)*

Participants agreed that the service could help people to live more independently at home for longer. It was seen to be non-intrusive and some tended to 'forget that it was there'. The service was perceived as easy to use and the sensor messages received were believed to be appropriate for communicating wellness of their loved one.

> *"I think it definitely gives the family member or carer or whoever gets the message a bit of reassurance and that's good. I mean it's, I feel it's all basically part of trying to keep people in their own homes for as long as possible, and that's what so many older people do want." (Debbie, Responder, Neighbourhood 4)*

> *"It's really easy, and I'm using it really easily, because it's just there and you forget about it." (Theresa, User, Neighbourhood 3)*

The installation experience

Generally participants were satisfied with the installation process and felt that the instructions they received were adequate, though the clarity of the information could be improved and fuller definitions of some of the terms used in the instructions, e.g. 'Activity Monitoring' could be provided. Most participants felt that the service should be available as a self-install, plug and play option.

Experience with the sensors

Overall most participants were happy with the appearance of the sensors. In general sensors worked well and were unobtrusive. Participants perceived the sensors to be appropriate to measure wellness in the user's home.

Neighbourhoods that included a user with dementia experienced some difficulties; one user did not recognise the equipment, confusing it with an alarm clock and another habitually turned off all electrical appliances at the wall prompting a 'mains failure' audio alert on the AroundMe™ system.

Communication within the neighbourhood

Generally participants were positive about the way that the service communicated information on wellness and activity to the neighbourhood. Participants liked the affirmative, simple messages and preferred to receive them on their mobile phones rather than their landlines. However, some people felt strongly that the message required personalisation to the users and some changes to the timing of messages were needed to fit in with lifestyles needs or because the system had been incorrectly programmed.

> *"I found it a bit odd, the first message. 'Your friend is active' and it didn't click just for those first 30 seconds, and you kind of think, is this a scam? What is it? And then it clicks and of course, I was expecting it, but it was just that 30 seconds of, you know, what is this?" (Dawn, Responder, Neighbourhood 5)*

Changing relationships

Although the majority of participants reported that the service had not changed their relationship, subtle changes were evident from interview data. For some, rather than reduced contact, the text prompts became the catalyst that initiated more contact with the user. Neighbourhoods became more aware of the users' wellbeing. This enabled the sharing of caring duties and responsibilities within families. Other neighbourhoods felt an increased sense of independence and freedom for all parties. Some participants expressed that the experience had further supported and reinforced relationships.

> *"It's given me a bit more freedom as well." (Karen, Responder, Neighbourhood 3)*

> *"I wouldn't say it has changed the relationship, I think it makes me much more aware of when he is having bad days and good days." (George, Responder, Neighbourhood 9)*

> *"I think we are far more focused [now] aren't we? Even at the weekend, I mean at the moment we are far more focused about mum, still needs to get up to have her breakfast, and then Gary is doing the Saturdays and I'm doing the Sundays to make sure she is eating so yes I think it has, it has helped us to focus hasn't it?" (Susan, Responder, Neighbourhood 8)*

Effects on daily living routines

On the whole, the system had little reported effect on activities of daily living for the users who carried on as usual. The system did, however, increase the confidence with which the users carried out their routines or could act as a prompt. One issue identified by some was the need for the system to be more flexible to accommodate change in routines e.g. at the weekend when people wanted to lie in. Others would have liked additional alerts for reassurance throughout the day.

> *"Funnily enough, I would say yes it has [increased confidence]. it's just that quiet knowledge that you know, if the worst does happen I'm not going to panic quite so severely, sooner or later somebody will know." (Heather, User, Neighbourhood 12)*

> *"I still do the same. The only difference is that, from a mind-set if you like, it's just comforting to know that somebody is watching over me." (Phyllis, User, Neighbourhood 9)*

> *"Yeah I feel safer, it always sends a text through about me doesn't it?" (Belinda, User, Neighbourhood 6)*

Staying at home for longer

All participants interviewed felt that the system could help older people to stay in their own homes for longer as it provided a safety net should anything untoward occur.

> *"Yes [it would help people to stay at home for longer]. That's a very definite thought. And which a lot of us really want to do. That is really what it's for in my opinion. Gives you your independence a lot longer without being intrusive by lots of people fluffing around and worrying and trying to persuade you to go into a home." (Heather, User, Neighbourhood 12)*

Concerns about technology

Overall participants were not concerned with the type of technology used and the methods of alerting families to wellbeing messages. Sensors that could include the use of cameras would however cause concern.

> *"Initially I didn't know whether it would bother me, but it doesn't at all. Certainly if there was any camera work going on that would bother me. I would feel like I would have to dress instead of lounging around in a dressing gown …Yes, full make up, but no its perfect, absolutely perfect …I was telling somebody about it and they said 'Well don't you feel it's a bit Big Brother?' …I said 'No, not at all and they can't see you." (Wendy, User, Neighbourhood 10)*

Using the service in the future

All participants said that they wanted to continue using the service, and that the service could be provided at scale via housing associations as well as sold to individual families. When they spoke to other people and friends about the trial, the service had received positive responses from others who felt they could also benefit from it.

> *"Yes I do [want to carry on using the service]. Well, I ain't going to get any younger let's put it like that. And I've got certain problems that are only going to get worse as I get older so I think as long as I'm mentally capable, which touch wood I am, I would, yes, definitely. If it meant that I could stay here longer…" (Heather, User, Neighbourhood 12)*

> *"Yes [I would like to carry on using the service], absolutely. Because [my mum] would like to live in her own home for as long as possible and I do think this [would help]. I work and my sister works and my sister is not around and I think this would put off for a length of time the fact of her having to be moved into my house or moved into care. So yes I could see us using it." (Lois, Responder, Neighbourhood 10)*

Following the completion of the living lab two further co-creation workshops were carried out to further refine the service blue print and explore marketing, branding and pricing of the service within a consumer market.

Discussion

Findings were overwhelmingly positive about the use of the technology and the impact it had on the relationships within the personal neighbourhood networks. Participants found the service reassuring as it provided positive "I'm OK" messages about the individual's status, it addressed previous concerns that some of the participants had been worried about in terms of finding ways to support the main user and it did not intrude on existing lifestyles as the service fitted into their daily lives and routines. In addition the service did not detract or reduce social contact experienced by participants. Conversely, the service increased the level of social contact in some of the neighbourhoods. Participants across the board felt that the service was about wellness and activity of loved ones, as well as keeping warm in the home.

All participants felt that the service should be able to be self-installed; although it was recognised that some customers may require a friend or a family member to install the service for them. For customers who would prefer not to install the system themselves, an inexpensive, reliable and friendly installation service should be offered at a small extra charge. Customers wanted to be guided through the set up process whether they opted for the self-install or the install option, and to have a reliable support system if things went wrong. Any consumer service must be able to offer good customer support to become a reliable market leader in this space.

All participants (winter trial users, responders and carers and co-creation participants) said they would be happy to pay for the AroundMe™ service. It was considered that who would actually pay for the service (user or carer), would depend upon the individual family, although amongst the winter trial participants', the majority of users said that they would want to pay for the service themselves. Overall, participants wanted a variety of payment schedules and options to allow them to choose the most suitable payment plan for their family's circumstances.

Interestingly, in the winter trial, not all participants initially saw the need for the service within their own family (and were only participating because another family member wanted them to, or they 'just wanted to take part in research'), however once they had used the service for a number of weeks, they found the service invaluable. This has important implications for the promotion of the service, and suggests promotional activity and marketing should encourage customers to adopt the technology at an earlier stage than they might consider necessary.

Participants wanted to receive information about the AroundMe™ service from a variety of sources including charities, the internet, advertisements, magazines, government brochures, housing associations, local councils, GP surgeries, pharmacies, newspapers, and the Citizens Advice Bureau. The majority of participants wanted to see this type of service provided by an assistive technology company, an energy company, a charity, or a partnership combination of such companies. Trust and brand acceptability are key influences that affect the consumer's perception of a product or service and must be taken into consideration in terms of who will be successful in taking new technology based services such as AroundMe™ into a consumer space. Trusted brands that have a large customer base and reach will be needed to mainstream this type of service within a consumer market as opposed to statutory services.

Success of the service design was due partly to the application of established design principles (UK Design Council 2010) to make the service effective and desirable and partly due to key stakeholder involvement in that design process i.e. older people and their support 'neighbourhood' to develop a simple service that fits technology into the daily lives of users alongside testing of the service in a real world situation. The service is now being developed as a customer installation proposition and commercialised with business modelling by the Advanced Digital Institute to roll the service out across the UK to customers.

Conclusion

The importance of conducting Living Labs, that is exploring innovative new products and services in situ, is clearly demonstrated in this project. The use of existing telecare technology allowed the testing of a service concept without commitment to a final technology solution. For the pilot stage, it was important to focus on a user centred design approach, and test the concept of the service prior to developing final technology solutions. To that end, the initial pilot was supported by repurposed telecare equipment, which was not the ideal technical solution for a full service, but sufficient to trial the users' perceptions of the service experience within the Living Lab. By including both potential users and industry stakeholders throughout the development of the AroundMe™ service, and adopting an iterative attitude to the research and service design, we are close to the development of a scalable service and large-scale commercialisation. The authors have been able to see the value Living Labs and co-creation can bring to service design through enabling the testing of concepts and prototyped services in situ. For this reason, the authors would recommend Living Lab and co-creation methodologies to enable useful, valuable and scalable services to be developed, deployed and evaluated with the end users, quickly and effectively prior to large scale implementation.

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Acknowledgements

The authors would like to thank: all our participants, their friends and families for taking part in the Living lab, many of whom we came to know well, for their support in developing the service; all the organisations that helped us with recruitment for the living lab and co-creation workshops; Tynetec for their telecare equipment and efficient installation and helpful staff and the Technology Strategy Board for funding.

About the Authors

Dr Gillian Ward is an occupational therapist and a principal lecturer in assistive technology at the Health Design and Technology Institute, Coventry University. She has a keen interest in the use of assistive technology to support older people and those with long term conditions and leads applied research and usability studies of assistive technology products and services.

Ms. Nikki Holliday is a Senior Research Assistant specialising in informing assistive technology design through user-centered techniques such as co-creation, co-production, usability studies, interviews, and rapid prototyping. Nikki has an undergraduate degree in Psychology (University of Leeds, 2005) and an MSc in Assistive Technology (Coventry University).

Mr Darren Awang is Course Director for the MSc in Assistive Technology. He has led and supported the development of innovative curricula for assistive technology. He has undertaken a number of diverse funded applied research projects that have included consultancy, knowledge transfer activities, CPD, training, accreditation activities, development of online learning materials and product evaluations.

Mr David Harson is an experienced senior engineering manager with the Advanced Digital Institute, leading their programme of commercial and public funded projects. His background includes communications and aerospace sectors.

Action Reseach in Developing Digital and Virtual Services with and for the Elderly People

Paula Lehto, Laurea University of Applied Sciences, Finland

Abstract

There is a challenge to develop digital and virtual services that enhance and make possible the development of the ecosystem in health care and social welfare context. Especially there is the demand to develop new digital and virtual services to respond the needs of the elderly people living at their own homes. Actors such as cities, companies, academic institutions, and professionals from public and private healthcare and social welfare field and users as clients are needed for designing new digital or virtual services especially for the elderly people. Independent living, accessibility and availability of health services are important in ageing society. The purpose of this article is to describe and consider how action research can be applied in a development work of digital or virtual services with and for the elderly. Action Research is presented through the Safe Home project as a case example. The Safe Home -project was based on an Action research and user-driven methods. The findings of the Safe Home project will be described in interactive CaringTV context from eldelry people´s point of view. Action research as the methodological approach is congruent when the aim is to produce new knowledge or to develop new methods e.g. digital services with the users in real life context.

Keywords

Action Research, CaringTV, digital services, elderly people, user driven methods, virtual services

Introduction

European countries are increasingly facing the challenges with an ageing population. From the point of view citizens the need for eHealth and especially new digital services (Digital Agenda in Europe 2012) is growing all the time in health care and social welfare sector especially for the elderly people. Working life, organizations and educational settings require new digital and virtual learning methods and interventions.

There is a demand to develop eHealth services that enhance and enable the development of the ecosystem of health care and social welfare. Actors such as cities, companies, academic institutions, and professionals from public and private healthcare and social welfare field and users are needed for designing new services towards eHealth. Through the development of eHealth, it is possible to change structures and processes of healthcare and social welfare services towards user-driven goals.

Independent living, accessibility and availability of new services are important in ageing society. In Finland, a number of reforms have taken place in the provision and allocation of social and health care services over the last decade. The Finnish government programme emphasises on user-driven, comprehensive and effective social and health care services and implementation best practices. The programme commits to ensure good care services for the elderly and providing preventive health services. Specifically, the aim is to promote the home care, the support services, and the independent coping and living of the elderly. The KASTE Programme 2012–2015, The National Development Programme for Social Welfare and Health Care, focuses on issues related to the elderly people. The National Health 2015, Public Health Programme, underlines that illnesses can be prevented and the functional abilities of elderly people can be promoted and rehabilitated to support their autonomy. The new act "Act on Supporting the Functional Capacity of the Older Population and on Social and Health Services for Older persons" (980/2012) notes that supporting the wellbeing and health, functional capacity and independent living of the elderly people are important issues in the ageing society. The content of the act also focuses on improving the elderly people´s opportunities to participate in the decision-making, developing needed services, improving e.g. guidance in using services to response the individual needs of the elderly people and strengthening their opportunities to influence the contents and the way of provision of the services.

The purpose of this article is to describe and consider how the Action Research can be applied in a development work for digital or virtual services in the context of health care and social welfare. This paper explores action research, the methodology and the characteristics of action research. The Safe Home -project is based on action research and will be used as a case example.

Action Research as a methodological approach

In the literature the action research is seen either as methods or as a methodological approach (Caughan & Coughan 2002, Kuula 2000, Reason & Bradbury 2008). Action research is based on the critical knowledge interest and its goal to produce new knowledge and forms of operation (Kyrö 2004). According to e.g. Kuula (2002) action research can be seen as an approach or a method. The approach of the action research is based on the critical knowledge interest. Also it demonstrates the emancipatory scientific approach. The basic principles of action research are practicality, actors´ participation and the creation of new activities or the interventions related to the concept of change. (Kuula 2000, Moore et al 2012). The table 1 below shows knowledge interests in research and the position of the action research in it.

Table 1. The knowledge interest and research process (see e.g. Habermas 1974, Kyrö 2004, Niiniluoto 2002)

Knowledge interest	Technical	Practical	Critical
Methodological approach	quantitative approach	qualitative approach	emancipatorical approach
Purpose	to measure to explain to control	to describe to understand to inteprete	to participate to engage to create to innovate to change
Methods	questionaires measurement tools	interviews, depth interviews, storytelling, narratives, videos	participative action research methods creative methods and tools participative observation pilots
Task	reason - conseqvences	understanding meaning of the phenomenon transition of the tradition	critical reflection sharing, cocreation continueity of evaluation

Action Research interferes with people as a social group and with an associated change in working life. The need of the change is one of the reasons to choose action research as an approach to develop something new. Action research supports e.g. stakeholders to participate in decision making through all the stages in the process. Continues evaluation offers direct changes towards the aims of the research process (Reason & Bradbury 2008). Through action research e.g. health care professionals collaboratively engage people to promote and guide interventions in a community (Bevan 2013.) Action research focuses on solving the problems or finding new ways in real life situations, in a specific context through active participation during the cyclic and iterative process. The intention of action research is to find out solutions or improvements on practical problems (French 2009.) The process of action research is systematic and includes reflective way to achieve a deeper understanding of the content and the context. The development process is linked strongly with the change.

The research process includes and follows the phases of the Action Research. The subjects of the research are active participants in the process. The process is cyclic. The aim of the research is practically oriented enabling planning, action and evaluation. In action research process multiple data collection methods are used. Methdos can be various and multiple (Reason & Bradbury 2008.) The chosen methdos should be congruent with the purpose of the research and the chosen methods should support tasks during the research process. The actions are analysed, alternative solutions to problems are reflected and developed, and new knowledge and operating models are produced (Caughan & Coughan 2002, Kuula 2000, Reason & Bradbury 2008.) The table 2 shows some of the characteristics of action research compared to a case study and user-driven methods.

Table 2. The characteristics of action research, case study and user driven approach (Heale 2003, Heikkinen 2001, Yin 1994)

	Action research	Case study	User-driven methods
Purpose	to change to empower to cocreate	to describe to undesrtand	to involve and to commit to share knowledge, experinces and skills to grasp the meaning of the tacit knowledge
Process	dialogical and critical reflection active participation cocreation	retrospective describtion	to test and pilot in real life context
Actors' role	subjects seen as partners active partnership	a case can be an individual, a group, an unit, an organization	Participative as an investigator as an innovator

The Safe Home project as a case example - Action Research in the process of developing digital services

The Safe Home -project was funded by the European Regional Development Fund (EU/ERDF) and implemented in Finland in the regions of Uusimaa, Kymenlaakso and Southwest Finland during 2008 and 2011. The project was coordinated by Laurea University of Applied Sciences (Laurea). The key partners were Laurea, Turku University of Applied Sciences, The City of Espoo and the City of Turku. Also seven entrepreneurs as business partners were actively participating in the project. (Lehto 2011, Lehto & Leskelä 2011)

The main context of the Safe Home project was the interactive CaringTV® as a platform and as a concept. The interactive CaringTV is a Finnish innovation which has been developed since 2006 by Laurea together with City of Espoo and with the company TDCSong (nowadays Videra Ltd). As a platform CaringTV is based on video conference technology. CaringTV was developed through action research during three research projects (Piirainen 2008, Lehto 2008, Raij & Lehto 2008, Lehto 2011, 2013.)

The purpose of the research in the Safe Home -project was to investigate, develop, produce and evaluate eHealth services with various client groups. The interactive programme and selected eServices through the interactive CaringTV were implemented during the process. The ultimate aim of the project was to promote clients´ health and welbeing, rehabilitation and support for independent living at home through digital or virtual services.

The participants in the study were elderly people (N=176), families with small children (N=4) who were clients of child welfare services, young people (N=28) who were clients of child welfare services and lived in family support centres, mental health rehabilitation clients (N=4) and disabled persons (N=12). Also experts (N=105) from different environments in health care and social welfare participated in the study. The elderly people as users were the largest group in the project. The collaboration between clients, students, municipalities, enterpreuners and third sector partners was the basis during the project. The co- operation was active and intensive. The involvement and participation of the actors enriched the process and offered multiple content (Lehto & Leskelä 2011, Lehto 2013.)

The action research as a process in developing digital and virtual services with and for the eldelry people

The research process in Safe Home -project followed the phases of the action research. The process is cyclic and the aim is practically oriented enabling planning, action and evaluation (Caughan & Coughan 2002, Kuula 2000, Moore et al 2012, Reason & Bradbury 2008.) The cylic process in Safe Home –project is presented in figure 1.

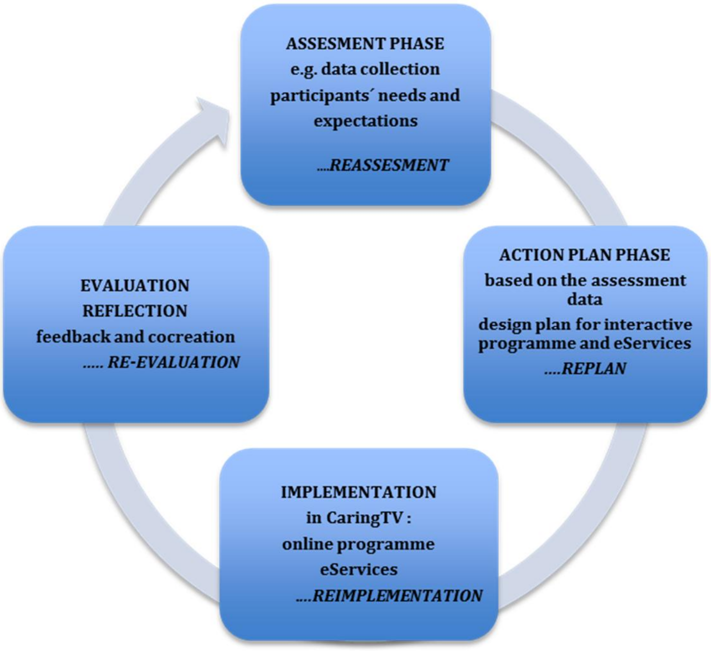

Figure 1. The process of action research

In the Safe Home -project the data was collected using multiple methods. In the assessment phase the data was collected through the individual interviews and focus group interviews. The aim of the first stage of the data collection was that all the participants users, clients and experts were interviewed in order to map and analyse the needs and expectations of the participants. The workshops were used for producing and assessing new ideas during the process. (Lehto 2011, 2013). Elderly people, experts and enterpreuners participated actively and intensively in the workshops and produced a lot of ideas.

The engagement of the participants, active participation and shared reflection during the process offered rich data and demonstrated the voice of the participants. All the participants were both service users and concept developers. By the use of the data triangulation and the multiple methods (Begley 1996, Silverman 2001), it was possible to grasp the meaning of the feedback and experinces of the participants. This data was extremly important in order to change and correct the actions during the project and to synthetize the final findings of the Safe Home -project. All in all the data collection was conducted three times through individual interviews, focus group interviews and workshops (Figure 2).

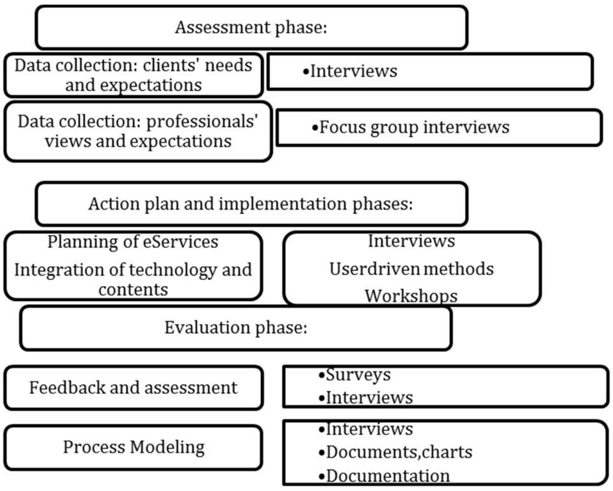

Figure 2. Phases of the data collection and used methods

The data analysis was done first independenly during the different phases of the action research. The grounded theory, using Six C´s and theoretical coding (Glaser 1978, Glaser 2013) was used. The synthesis of the data collections was presented as the final findigs of the Safe Home -project.

During the action research process the changes and corrections were made based on the feedback and reflections of the participants. The aim of the development was towards more and more participatory way in producing interactive online programme in CaringTV. In the same time users´ feedback about technological aspects e.g. the feedback of the voice in CaringTV or the clearness of the picture were taken seriously (Lehto 2011.)

Findings based on the process of action research in Safe Home -project

In action research the findigs can be utilized directly during the phases of the action research. For example, in Safe Home project the findigs were divided and described based on the assessment phase, implementation phase and evaluative phase. The themes of the programme for the interactive and online CaringTV were emerged from the data collected from the users and the experts. The participatory and interactive programme were named based on these emerged themes. (Figure 3)

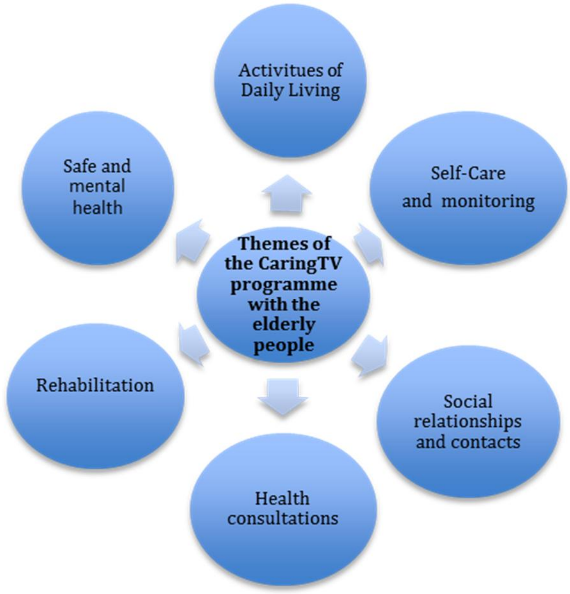

Figure 3. Themes of the interactive programme in CaringTV

The contents of the interactive online CaringTV programme were the support of the elderly people in their everyday life, safety, activities of daily living, supporting social relationships, participation in rehabilitation such as physical exercises, managing self-care, and health issues. The active participation in CaringTV programme in the Safe Home -project supported the functional capability and everyday coping of the elderly people as individuals or as a group, and provided meaningful activity for their everyday lives. During the implementation phase of the project elderly people presented also ideas for their own meetings organized by themselves. These online and flexible meetings happend during the evening times and during the weekends. These self-directive programmes and meetings were popular among the elderly people.

During the evaluative phase of the action research the data was collected in the workshops. The new services based on the ideation are summarized in figure 4. The eServices were implementaed and piloted in CaringTV context.

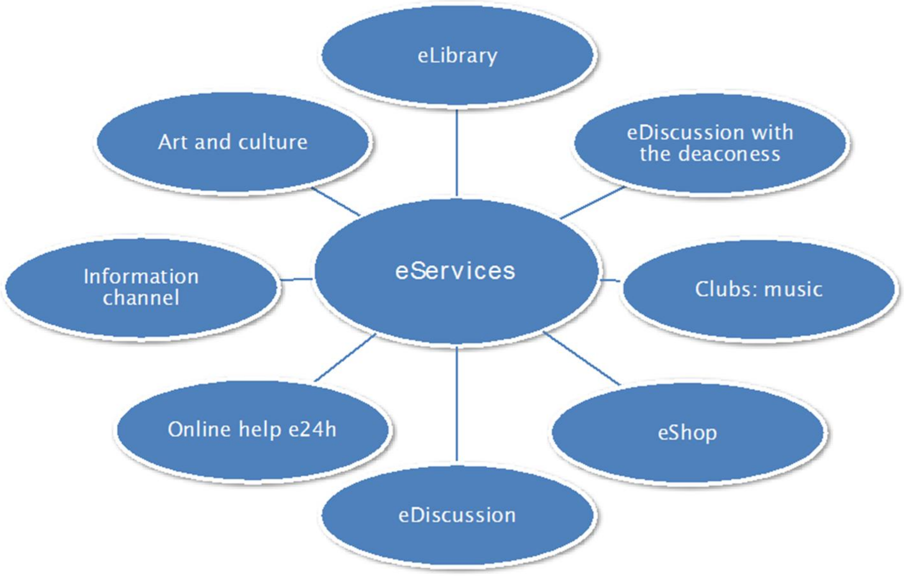

Figure 4. eServices as the finding of the workshop

The development work of the eServices added and strengthend added value for the interactive CaringTV as a service concept. Piloted and tested eServices included eDoctor, eNurse, ePhysiotherapist, eDeacon and e Liberian meetings and virtual consultations. ePharmacist, eClubs and virtual calls were also piloted during the project. The eServices as the new methods or interventions supported elderly people´s empowerment and engagement. This also enriched the interaction and relationships with the eldelry people as clients and experts. (Table 3.)

Table 3. eServices

eServices in CaringTV platfrom	Aim of the eService	Content of the eService	Participants
eNurse	to promote and to support clients´ health and wellbeing to advice and discuss	health issues social relationships daily activities feelings interactive programme	elderly people
eDoctor	to support health and give information (illnesses, symptoms, and cure)	medical checks and quidance to give consultations	elderly people experts e.g. nurses
ePhysiotherapist	to support and encourage clients´ to remain or improve their functional and mobility skills and abilities	personal and group discussions	elderly people
eDeacon	to discuss with the clients to support clients´ spirituality and coping in every day life	personal and group discussions	elderly people
eLibrarian	to discuss and to support reading-, music- and art hobbies and intrests	literature and reading sessions music and singning sessions	elderly people

During the Safe Home -project new virtual and interactive online eServices and solutions were piloted and developed via CaringTV with the users and with the other participants. The analysis of the feedback data showed the evidence, what the meaning of virtual services for the elderly people was and how the virtual and the user-driven interactive programme and eServices empowered the most of the elderly people living at their own homes. Also the feedback from the significant others was encouring. Through the action research the focus of the activities in the Safe Home -project was on empowering elderly people to involve and participate actively in the project in order to live independently at their own homes, avoid institutionalisation of some of the elderly people and support active and happy life. The following quatations are from the data collected from the elderly people:

> *"We are like a big family"*
>
> *"Participation in CaringTV is the important moment in my day "*

Conclusion

The Safe Home -project was used as a case example for analyzing and ensuring how action research can benefit the development work of new virtual services for and with eldelry people. CaringTV has been a context where these interactive programmes and eServices have been cocreated and produced together with the actors. The findings and the knowldge gained during the action research process in the Safe Home project reflect the grounds how the action research can be beneficial in the development work. As a conclusion the following statements of the analysis from the implementated action research in the Safe Home -project are:

- the actors are engaged and committed in finding new ways and methods in the health care and social welfare context
- the research findings can be taken directly in use during the process
- the process in action research is agility and flexible
- the feedback is continues and can be taken in account quickly
- the process is related strongly in the context
- the developed new methods, interventions, services etc. can be quickly anchored in real life during the process
- the transitions towards the change process is demanding

Action research might be sometimes messy and time consuming and it requires researcher to establish communicative space (Bevan 2013) but it is rewarding approach. In the Safe Home -project this was noticed and recognized. Still during the process of the action research users´ voice and participation were unique and necessary in order to acchieve the purpose of the study and especially to support and promote eldelry people´s empowerment through and towards user-driven approach in developing new and digital eServices in health care and social welfare field for coping at home.

Health technology such as CaringTV and user-driven methods can be utilized in developing eHealth services for empowering elderly people for better and healthy life and for independent living at their homes. Users´ active involvement and integration of the new technology in real life environments is the modern way to enhance the best benefits for the users in health care and social welfare. Future development of new eServices, methods and health products with and for users e.g. eldelry people can be the key element in effective and user centred selfcare modes. Based on the research findings of the Safe Home project and the analysis used in this article, there is still a huge challenge to develop more digital or virtual supportive systems and services from multidisciplinary cooperation for and with the elderly people and with their significant others e.g. for those elderly people who suffer loneliness and memory problems. Similar findings and challenges have been presented also in earlier studies in CaringTV context (Lehto 2008, 2011, 2013, Raij & Lehto 2010). The most important issue will be to share the knowledge and to cocreate more tailormade and user-driven virtual and online services and ways to support clients´, especially elderly people´s and their significant others´ life, health and wellbeing.

Discussion

The existing challenges relate to develop more deeply eHealth concepts such as CaringTV and other technological solutions to response the expectations and needs of different client groups and to correspond with the development and availability of eHealth services. The productisation of the concept and new business models are still the challenge in health care and social welfare field. For example a successful transfer of CaringTV concept requires close collaboration with local authorities, service providers and customers.

New solutions should combine health, social care and smart living systems and 'age-friendly' environments. These can be developed through Living Lab approach and through action research. There is a demand to create and implement user-driven eHealth services, new and multiple applications and other innovations to support individuals´ selfcare in health care and social welfare context (Topol 2013.) The challenge is to produce personalized services co-created by users e.g. elderly people and their significant others and professionals through ICT use (Digital Agenda in Europe 2012.) More studies based on e.g. LivingLab approach (Leminen & Westerlund 2011) are needed for transforming new ideas and innovations to change the present situation in health care and social welfare towards user-driven solutions.

By applying the action research and its cyclic process tailor made and effective eServices can be cocreated, implemented and evaluated in real life contexts. Now it is the time to renew the structures, processes, services and methods in health care and social welfare field. The existing challenges still relate to develop more intensive and situational based user-driven eServices for and with the elderly. Further research is needed into the development of eHealth and new eWellbeing services, the availability of services, the development of new service/client processes. Research of the systematic evaluation of costs and effectiveness is required.

The challenge is to meet the expectations and the needs of the elderly people and their significant others and to correspond with the availability of digital and virtual services. Successful transfer of tested virtual services requires close collaboration with local authorities and different service providers as a public-private partnership. Further research is needed into the development of new eWellbeing services, the availability of services, to open the new service/client processes, and to do systematic evaluation of the impacts such as costs and effectiveness. From the academic point of view, also the education and new integrated programme should be developed to response the challenges.

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About the Authors

Paula Lehto PhD, Health Sciences is working as a principal lecturer at Laurea University of Applied Sciences. She has done her doctoral thesis in Health Sciences, Family Nursing Science year 2004 at Univeristy of Tampere, Finland. Her research interests are health and wellbeing of families, elderly people´s health, eHealth and virtual health services and learning methods. Her methodological competence is in Action research, Grounded theory, Qualitative methods and Userdriven methods. She has been involved in interactive CaringTV® studies such as EU/ Going Home and Safe Home RDI projects since 2006. Her present research project is called mHealth Booster (2013-1014) funded by the Centres for Economic Development, Transport and the Environment (ELY Centres). She is responsible of developing the curriculum of Master of Health Care Programme at Laurea, Otaniemi unit. She is the board member of Finnish Society of Telemedicine and eHealth.

Knowledge Management of Open Innovation in Digital Ecosystem Building – Role-Based, Situation-Aware Personalisation in Smart Real Estate Business

Mervi Himanen, Pirkka Frosti & Sonja Frosti, Digital Living Finland Oy, Finland &
Timo Varjo, Aalto University, Digital Living Finland Oy, Finland

Abstract

The open innovation has a new mental thinking pattern, but the scientific methods for user-studies and practicalities following them utilise the traditional research methods. A common nominator in modern agile software development is not only the emphasis on the end-user involvement, but the iteratively progressing processes. The correlation between the approaches of open innovation process and a selection of RTDI process frameworks with emphasis on the end-user involvement and iteratively progressing processes was examined. The empiricism originates from the RTDI in smart technology. Narrative approach and deductive reasoning have been employed as research methods.

The traditional concepts for design methodology either match the open innovation working method or the need for adjustment and integrated methodology can be recognized. The first estimation of the correlation between the knowledge management theory on knowledge transformation modes and the knowledge creation in the agile design phases has been drafted.

The co-creation is proved to be a powerful tool even when using basic user-study methods when targeting results based on input from users in the true user situation or environment. Respective and warm-hearted attitudes among the key operators count. However, the communication with the potential clients and customers is challenging. On one hand, it is not a norm to accept the approach that feedback from the customer's customer counts best. On the other hand, the methodology of how to face the customer needs and desires is lacking in the RTDI practice of open innovation.

As the applications need to be personalised and role-based and also event-aware and situation-aware, the deep understanding of the end-user needs and desires is crucial. However, when the target is to solve the customers' problem, a collection of user-requirements or user feedback of the service is not enough. The

focus is not only in the understanding the customers' problem, but provide tools for solving them to enable smooth going activities or profitable business. The service idea dictates the goals and methods of open innovation. Event-aware programming and linked data technologies are employed by the Digital Living Lab to tackle the interoperability of the software provision and related customer applications.

Keywords

Digital knowledge management, industrial engineering and management, Industrial Internet, living lab, open innovation

Introduction

User Involvement in Smart Urban Environment Development

The progress of user involvement in the RTDI (Research, Technical Development and Innovation) of smart technology will be referred shortly by jumping from one milestone to another and with a few examples of each. Wellbeing, interoperability and transparency in society urge rational use of information and software. Integration or linking and use of big (latest data management of large and complex sets of data) and open data (e.g. opening the public registers for public use) provide a multi-disciplinary and cross-sectorial task for open innovation. However, for time being **isolated islands** of solutions in real estate and building based on the ICT (Information and Communication Technology) exist as described in following.

Although the best ideas might pop up somewhere else than in research laboratories the meaning of education cannot be denied. University education in Finland lacks special programmes for the multidisciplinary subject of **computer science in urban environment design** - such programmes as that on intelligent building technology in the Reading University or in Temasek Polytechnic in Singapore - excluding the master's programme in geoinformatics at Aalto University. In turn, two research focus areas have been dedicated to **cooperative research on information technology and human sciences**: [a]Helsinki Institute for Information Technology (HIIT), a joint research institute of Aalto University and the University of Helsinki, and [b]Strategic Usability Research Group STRATUS at Aalto University.

Islands in the Digital Building Ecosystem

The **digital ecosystem building** for the real estate and building, as well as, for smart city lacks integration and links between separately evolved software - if it even is possible to understand ecosystems without a holistic systems design or entirely new software development methodology. Building design includes such digital methods as the BIM (Building Information Management; Standard IFC 1.5.1, 2.0 and 2x (the open format IFC, Industry Foundation Classes), the CAD (Computer Aided Design) including visualisation and quantity survey, the clash calculation or the FEM (Finite Element Approximation) analysis and other software for calculations in engineering.

Software supply for the most resource consuming phase of building life-cycle - the usage of buildings - is lacking. Such concepts are in use as electronic buildings service manuals and energy labelling - e.g. EU Ecolabel, LEEDS, and BREEAM, Green Label Singapore or WWF Green Office and many more in number, which take advantage of basic software without any intelligence. The real estate asset management managing building stocks worth of billions might rely on files only listing the items and summarising them. The energy simulation software used during the design phase comprises parameter from the architectural design, FM and building services and automation. Several applications in simulation have been developed such as DOE 2.1E, ENERGYPlus, etc. They lack algorithms based on evidence from verified data. Further on, the realisation of verification lacks cost effective sensor networks. The RTDI on these study problems is under way.

The building automation, introduced in 1950's, has relied on industrial standards being thus a stand-alone closed application involving the building service equipment alone. The building automation systems have included a module for user interface. However, many building owners have considered it too costly to purchase. The latest development in building automation focuses on the total building performance, the metrics needed, development of sensor network and the minimising the sensor points. The advanced systems target towards web based service provision. It will make the integration of the building automation to other building information management applications easier.

The CAD software is applied also in land use planning together with the GIS (Geographic Information Systems) and the GPS (Geographic Possession System) which is employed also in applications needing navigation. Buildings and transport infrastructure lie on land. However, no uniform software application between these disciplines exists.

Aviation use sophisticated systems for air traffic control, airport operations and passenger services. The intelligent transportation systems (ITS) comprise the deployment of computer science in the field of road transport including infrastructure, vehicles, drivers and passengers, traffic and mobility management, as well as the interfaces to other modes of transports (EU Directive 2010/40/EU of 7 July 2010). As an example of user-orientation can be mentioned demand-driven public transport which has started to evolve.

Real Estate Business Developing Parallel to User Involvement

The forms of **real estate business**: asset, property and facilities management (FM) take place during the long phase of usage of the building (Leväinen 2013, Alexander 2002, Alexander et al 2004). The construction phase can be considered as an exceptional period of the building property life-cycle (e.g. Himanen 2009). However, it has been considered as the core of building sector due to its importance because of the lack of space to work or place to stay after the Second World War. The importance of the investment has been replaced with the more resource demanding latter periods of building lifecycle: maintenance, preparation and renovation periods up to demolition, after the high demand has been satisfied in a large quantity. In accordance with the growing importance of the usage phase also the scientific approach in the real estate discipline has become more sophisticated. Many theories in real estate business have landed from US to United Kingdom and further on become worldwide via the Commonwealth countries. Finland they reached in the beginning of 1990's (Himanen 2003, p. 78, Lindholm 2008). The Finnish tradition in modern real estate paradigm first evolved by efforts of Professor Kari Leväinen at Helsinki University of Technology (currently Aalto University) (1983-2007) as well as Professor Raimo Salokangas in building economics at Tampere University of Technology (1972-1998).

While the real estate business has grown in importance, the user involvement has grown in importance if it among real property managers never has been unimportant. They quite early realized how much it meant to the occupants or tenants if some attention was paid to their problems such as indoor environmental quality problems in sick buildings.

Traditional Scientific Methods and User-Studies

The open innovation has a new mental thinking pattern, but the **traditional scientific methods are applied for user-studies** and for practicalities following them. For example, gathering user-requirement or feedback comprises such methods as questionnaires, interviews, observation. Further on, open innovation can be based on an extended variation of the previous methodology or on their combinations, as well as, on the co-creation methodology. The use of several parallel methods is a proven tradition resulting into reliable outcome. Actually, it is a necessity even widely in science concerning human factors. Short user-studies by questionnaires have been a norm in property and facilities management companies to gather end-user feedback (cf. Post-Occupancy Evaluation – POE, Preiser 1989, Preiser & Schramm 1998, Preiser et al. 1988). Those questionnaires have moved into Internet. But is it all that is needed? Some building managers have even argued that listening without corrective actions is enough.

One of the **latest user-study methodologies**, the Living Lab - born in Massachusetts Institute of Technology MIT - emphasizes the end-user experience yielded from authentic use cases and true end-users. The European Commission has characterised Living Labs as Public-Private-People Partnerships (PPPP) for user-driven open innovation. The ENoLL, the European Network of Living Labs defines that a Living Lab employs four main activities (http://www.openlivinglabs.eu/):

- Co-Creation: co-design by users and producers,
- Exploration: discovering emerging usages, behaviours and market opportunities,
- Experimentation: implementing live scenarios within communities of users, and
- Evaluation: assessment of concepts, products and services according to socio-ergonomic, socio-cognitive and socio-economic criteria.

Bergvall-Kareborn et al (2009) conclude that a Living Lab is a gathering of public–private partnerships (PPP) in which businesses, researchers, authorities, and citizens work together for the creation, validation, and test of new services, business ideas, markets, and technologies in real-life contexts. The purpose of a Living Lab is to create a shared arena in which digital services, processes, and new ways of working can be developed and tested with user representatives and researchers. Hence, a Living Lab is an environment in which people and technology are gathered and in which the everyday context and user needs stimulate and challenge both research and development, since authorities and citizens take active part in the innovation process. However, Bergvall-Kareborn et al (2009) conclude:

> *"The methodology stresses user involvement in real world contexts. However, we find that there still is much work to be done before the concept design process truly meets the vision of taking place utterly in the users' real world contexts throughout the whole innovation process, as well as being truly user-driven."*

But is the Living Lab more than changing the location of studies out of laboratories or paying more attention to the quality of samples? The Living Lab concept highlights that research and experiments take place in real-life environments. It means that it is easier or even not possible elsewhere for researchers or producers to co-create with users. A Living Lab is a shared arena, test arrangement, research platform for service, process and product development where research expertise and user experience collide but do they interact or cooperate. Living lab as such is considered to be similar in its approach to other open methodologies.

Some further observations of the latest of user-study methodologies are:

- During the User Journey (Gordon 1998; Payne & Ballantyne, 1991, Nenonen et al 2008, Junnonen & Karhu 2012) the observer(s) can be the expert alone,
- PehmoGIS (Broberg year unknown, www.pehmogis.fi or http://home.mapita.fi/) is a questionnaire on a localised software and it is questionable if the use of software for data management makes it more user-oriented than traditional case study questionnaires with statistics on software (note: other grounds for picking the case than area are too),
- Owela (Open Web Lab, URL: http://owela.fi/) is a questionnaire on social media inviting service ideas from all type of users, but how far the interaction continues beyond the one time response and how eager people are to share their best ideas, and
- Workshops as modifications of Future Workshops introduced by Robert Jungk and Norbert Mullert (1987) make it possible to share both tacit and explicit knowledge in person face to face among expert and end-user participants, but still the structure of interaction define the level of openness. Further on, according to the group effect people might have different opinion in group than alone.

A common nominator of user-studies is that the outcome is the result of the experts' conclusions usually - or should it say always. Research organisations as consultants or think thanks may follow certain normative guidelines. Interests of those conclude may be left unattended. This concerns also dissemination to public - where the urge of a short reference of scientific results done by a non-scientist is problematic. Passing forward a neutral and correctly informative message of large studies or complex phenomena is not an easy task. Users conclude by sending reclamations or they are left unsatisfied.

Standardisation

The ISO (International Organization for Standardization) and the CEN (European Committee for Standardization), as well as, the Cenelec (European Committee for Electrotechnical Standardization) have launched **standards** related to user involvement and some of them are specific for building sector (e.g. ISO 21542:2011: "Building construction - Accessibility and usability of the built environment" or CEN/TS 16118:"Sheltered housing. Requirements for services for older people provided in a sheltered housing scheme") or computer science (e.g. ISO 13407 new version of ISO 9241-210: "Human-centred design for interactive systems", ISO 13407:1999 Human-centred design processes for interactive systems, ISO/TR 16982:2002: "Ergonomics of human-system interaction - Usability methods supporting human-centred design").

Multidisciplinary and Inter-Sectorial Stakeholder Groups

The use of multidisciplinary and inter-sectorial expert groups is a mean for reaching sophisticated analyses. Or are the experienced users alone better for this job? How complex a problem can be that human brain is able to comprehend enough for clear conclusion, a human brain, able to deal with 7 items at time in average (LeDoux 1998 pp. 271). Large post-occupancy studies preceded the creation of intelligent building concepts and realisation of smart buildings. Examples of these quantitative assessments are the ORBIT studies carried out by the Harbinger Group of Connecticut (Duffy 1983), the Intelligent Building in Europe (Anon 1992) and the Office Tenant Survey of the BOMA and the ULI (Anon 1999). They look the feedback in relation to the productivity of the building environment. Today, for example, studies carried out by Social Networks Analysis cover wide range of parameters with wide stocks of data, i.e. big data (cf. IEN Innovation Ecosystem Network, http://www.innovation-ecosystems.org/). The scope of studies on intelligent built environment has expanded into studies on the smart city phenomenon. The partners involved in research and innovation come from all walks of life not only from scientific disciplines (cf. co-smart-specialisation: S3 Smart Specialisation Platform: research by quadruple helix comprising academia, industry, public sector and end-users).

These user-studies involve various stakeholders acting as end-users - from individuals via business up to public organisations. The user categorisation of the AAL Joint Programme (Ambient Assisted Living, Anon a, 2008) makes it clear as follows:

- Primary end-user is the person who actually uses products or services, a single individual directly benefiting from them by increased quality of life.
- Secondary end-users are persons or organisations directly being in contact with a primary end-user, such as family members, friends, neighbours, care organisations and their representatives, benefiting from technology directly when using products and services (at a primary end-user's home or remotely) and indirectly when the care needs of primary end-users are reduced.
- Tertiary end-users are such institutions and private or public organisations that are not directly in contact with products and services, but who somehow contribute in organizing, paying or enabling them. This group includes the public sector service organizers, social security systems, insurance companies. Their benefit comes from increased efficiency and effectiveness resulting in saving expenses or having no increase of expenses in the mid and long term.

Such groups as consumers or residents can be considered as primary and providers as secondary end-users. Customers and clients may represent both groups. For example, an office worker represents the employer company in the position of a secondary end-user, but as a user of the office space she or he is a primary end-user.

Holistic Approach from Intelligent Building to Smart City

The first initiator of taking **end-user involvement into the intelligent building concepting** was the USA Intelligent Building Institute in 1988: "... optimal building intelligence is to matching of solutions and occupant needs ..." (Himanen 2003, pp. 57). The focus was on secondary end-users as it was in the large post-occupant studies too. The profitable businesses were targeted. It can be hypothesised that those large studies had an influence on the intelligent building concepts. In some contexts intelligent was understood only as a consequence of a collection of technology installed into the buildings.

No definition on intelligent building has been agreed, but the scientific ones include end-users in such as the metaphor between built environment and senses defined by a leading building automation company (Himanen 2003 pp. 55-65). Himanen defined the forms of intelligence of intelligent buildings (connectivity, spatiality, self-recognition, kinaesthetic, logic) using the Gardner's (1983) definition of human intelligence as a starting point (Himanen 2003 pp. 458).

However, these efforts to take a broader view into the phenomenon of smart urban environment have diluted among produces and the business lacks service providers to make it grow and profit. Still, Emeritus Professor Derek Clements-Croome argues in the latest book of intelligent buildings (ed. 2013) that

> *"… they should be sustainable, healthy, and technologically aware, meet the needs of occupants and business, and should be flexible and adaptable to deal with change. This means the processes of planning, design, construction, and commissioning and facilities management including post-occupancy evaluation are all important. Buildings comprise many systems devised by many people and yet the relationship between buildings and people can only work satisfactorily if there is an integrated team with a holistic vision."*

Caragliu & Nijkamp (2009) defined **smart cities** highlighting the growing importance of ICT together with two assets: social and environmental capital, in profiling the competitiveness of cities when they are introduced as a strategic device to encompass modern urban production factors in a common framework. This definition has also more technology-oriented counterparts defining the concept of the smart city

- as a city that uses ICT to make the critical infrastructure components and services of a city - administration, education, healthcare, public safety, real estate, transportation and utilities - more aware, interactive and efficient' (Belissent 2010), or
- as a urban centre of the future, made safe, secure, environmentally green, and efficient because all structures - whether for power, water, transportation, etc. are designed, constructed and maintained making use of advanced, integrated materials, sensors, electronics, and networks which are interfaced with computerized systems comprised of databases, tracking, and decision-making algorithms (Bowerman et al. 2000).

Looking the phenomenon from administrative perspective is not necessarily user-oriented approach. Smart metering is a technology push approach to smart city.

Both the intelligent building and smart city concepts include similar ideas to the open innovation - design marketable outcome without forgetting the qualitative design (inside the company) and the user involvement (outside the company).

Forms of User-Oriented Technology

Lastly, it can be pointed out of the user involvement in smart urban environment development that the role of the user depends on the maturity of the technology - the enabler. The ICT application is

- Technology pushed when product is made effective, operable, reliable, affordable, etc. in terms of resources for production,
- Market Driven when the quality is defined as letting the market, meaning the price determine the quality standards that a business applies to its products,
- User-friendly refer to the ease of use and learnability of a human-made object called usability, as well as to designed-for-all principles meaning that the use-friendliness concern everyone, and that the needs, wishes and expectations of users are taken into consideration in the design and evaluation processes of products or services (it includes future generations, regardless of age, gender, capabilities or cultural background, participating in the construction of our society, with equal opportunities and in economic, social, cultural, recreational and entertainment activities while also being able to access, use and understand whatever part of the environment with as much independence as possible),
- Tailor-made when a provider sets the application according to the user-requirements,

- Personalised when a user is able to adjust and use the system according to her or his own preferences,
- Role-based when a user is authorised to use various modules of the application and alter between them,
- Localised when the system is aware of its user's location and gives the feedback in relation to the location of the user,
- Situation aware
- Event-aware when it performs certain actions in response to user input.

Knowledge Creation

Agile Production Cycle in the RTDI of Software

According to Abrahamsson et al (2002) a development method is an agile one when it is incremental (**small software releases with rapid cycles**), cooperative (**customer and developers working constantly together with close communication**), straightforward (the method itself is easy to learn and to modify, well documented), and adaptive (**able to make last moment changes**). More detailed description of agile production method is given in Figure 1.

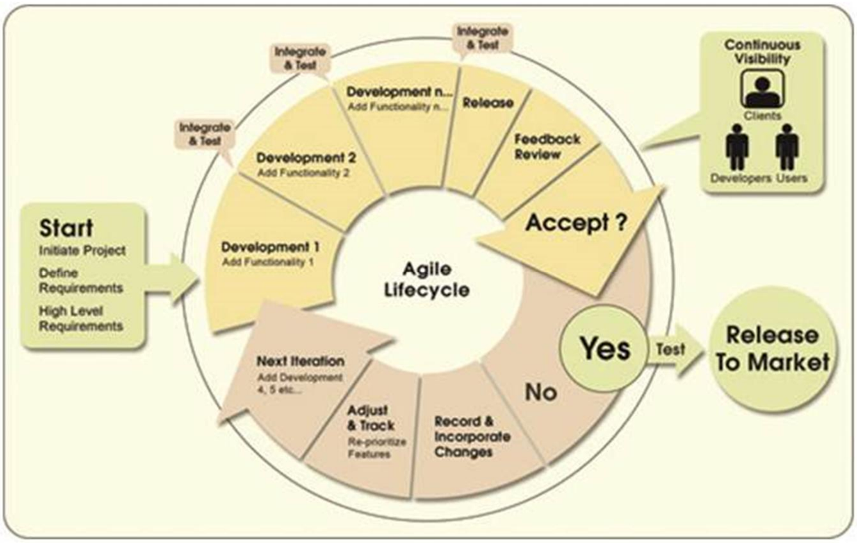

Figure 1. Agile Production Cycle (Unger & Novak 2011)

Service Design

Service design paradigm has been introduced relatively recently (Shostack 1982, 1984). It involves artefacts and other things including communication, environment and behaviours. Service design is the specification and construction of technologically networked social practices that deliver valuable capacities for action to a particular customer. It is the activity of planning and organizing people, infrastructure, communication and material components of a service in order to **improve its quality and the interaction between service provider and customers**. Designing according to the customer needs makes the service user-friendly, competitive and relevant to the customers. Together with the most traditional methods used for product design, service design requires methods and tools to control new elements of the design process, such **as the time and the interaction between actors.**

Open innovation

Chesbrough (2003) originally defined it as a paradigm that assumes that firms can and should use external ideas as well as internal ideas, and internal and external paths to market, as the firms look to advance their technology.

Co-creation

Co-creation is a form of marketing strategy or business strategy that emphasizes the generation and ongoing **realization of mutual firm-customer value**. It views markets as forums for firms and active customers to share, to combine and renew each other's resources and capabilities to create value through new forms of interaction, service and learning mechanisms (Prahalad & Ramaswamy 2004).

Already during the 1960s and 1970s the idea of a participatory design was introduced for urban planning in Finland, but did not become a norm.

Knowledge Transformation

The concepts of tacit and explicit knowledge are two key concepts in knowledge creation. According to Polanyi (1966) explicit means codified knowledge that can be transmitted in formal, systematic language. It is discrete or digital. It is captured in records such as libraries, archives and databases and is assessed on a sequential basis. It can be expressed in words and numbers and shared in the form of data, scientific formulate, specifications, manuals and the like. This kind of knowledge can be readily transmitted between individuals formally and systematically by speech and by writing and reading. In the west, in general, this form of knowledge has been emphasized.

Continuing referring to Polanyi (1966) it can be described that tacit knowledge is highly personal and hard to formalize, making it difficult to communicate or to share with others. Two dimensions to tacit knowledge are

- Technical dimension, which encompasses the kind of informal personal skills of crafts often referred to as 'know-how', and
- Cognitive dimension consisting of subjective insights, intuitions, beliefs, ideals, values, emotions, schemata and mental models which are deeply rooted in human mind and body and which often are taken for granted. We perceive the world via cognitive dimension and shapes.

Knowledge creation is a spiralling process of interactions between explicit and tacit knowledge (Nonaka 1998). The interactions between the explicit and tacit knowledge lead to the creation of new knowledge. The combination of the two categories makes it possible to conceptualize four conversion patterns defined by the Nonaka's and Takeuchi's learning cycle (Nonaka & Takeuchi 1995, Nonaka & Takeuchi in Tuomi 1999, pp. 324-326). The modes of the knowledge transformation are:

- the tacit knowledge is transformed into tacit knowledge through socialization,
- the tacit knowledge is transformed into explicit knowledge through externalisation,
- the explicit knowledge to explicit knowledge through combination and
- the explicit knowledge to tacit knowledge through internationalisation.

During the socialisation mode individuals may recognise their tacit knowledge using face-to-face communication or sharing experience directly at work. Tacit know-how or personal skills will never be shared if none work on it will be conducted.

The externalization mode means making tacit knowledge explicit. Dialogue is an important mean for. By articulating of one's own tacit knowledge - own thinking - to others: friends, customers, public audience for example, and getting instantaneous feedback followed by simultaneous exchange of ideas turns tacit into a readily understandable form, e.g., explicit knowledge.

Once knowledge is explicit, it can be transferred into other type of explicit knowledge through a combination mode. Explicit knowledge can be conveyed in documents, email, data bases, as well as through meetings and briefings. The key steps collecting relevant internal and external knowledge, dissemination, and editing or processing to make it more usable. Combination allows knowledge transfer among groups across organizations.

The internalization process transfers organization and group explicit knowledge to the individual. Internalization is largely experiential, in order to actualize concepts and methods, either through the actual doing or through simulations.

The concept of Ba provides a platform for advancing individual and/or collective knowledge. Ba was originally proposed by Japanese philosopher Kitaro Nishida (1970) and further developed by Shimizu (1995). Professor Ikujiro Nonaka adapts this concept for the purpose of elaborating SECI model (Nonaka 1998) of knowledge creation. According to the theory of existentialism, Ba is a context, which harbours meaning. Thus, Ba can be considered as a shared space that serves as a foundation for knowledge creation or for emerging relationships. This space can be physical (e.g. office, dispersed business space), virtual (e.g., email, teleconference), mental (e.g. shared experiences, ideas, ideals) or any combination of them.

Koskinen & Pihlanto (2008, pp. 35-36) describe that

> *"Knowledge-based competencies consist of an individual's tacit and explicit knowledge (e.g. Nonaka and Takeuchi, 1995). Tacit knowledge is knowledge that an individual has collected and stored in her worldview while she has performed different tasks and duties in different contexts and situations of her life. This means the duties in different contexts and situations of her life. This means that tacit knowledge is acquired by an individual as a result of active work (e.g. Polanyi, 1966). However, tacit knowledge can also refer to distorted knowledge that is culturally assimilated, and thus passively given to an individual (e.g. Popper, 1977)."*

They figure **out that an individual's personal competence comprises culture related knowledge-based competencies (e.g. tacit and explicit knowledge) and social-based competencies (e.g. attitudes, values, and relationships) forming the personal competence. Task to be implemented are bound to situation and leadership style. These human characteristics demand for the personalised and event- or situation-aware IoT (Internet of Things) concepts when items, people or actions in real world are aided by managing their virtual counterparts.**

Toivanen (2006) concluded in her study on electronic services in municipalities:

> *"Cooperation was considered in many municipalities to be a possible and necessary working method, but various barriers to realising it were seen. Yet the findings also point to new perspectives and opportunities for cooperation in information technology offerings. During the research work, other powerful factors affecting development of these services emerged: detachment from organisation of other administration and services, personification and leadership, as well as the value placed on attitudes and technology."*

The knowledge creation in design of intelligent building was described with the Building Intelligence framework by Himanen (2003, pp. 457-460). She found that the user feedback is different from buildings designed after intelligent building concept than from buildings designed without design or thinking focused on the intelligent building concepting. But it was difficult to identify meaningful structural or technological differences between the intelligent and the non-intelligent but high quality office buildings located in same city and being of same age. Presumable, quite similar design guidelines and building standards were followed in every case. The user feedback given in relation to the productivity of ones work was favouring the intelligent building. The user feedback was gathered from a wide variety of building properties and facilitation of amenities. The architectural feature of building mass size counted though - the bigger being better which is not in line of all other study results.

Afterwards, yielded from inductive reasoning on the basis of the previous research on Intelligence of Intelligent Buildings (Himanen 2003) Himanen could identify two phenomena:

- The mystery of the silent technical knowhow: There is not big difference in the standard of the technical apparatus in the intelligent and in other high quality office buildings, but the intelligent offices were evaluated better work places by the office workers.
- Empty space dilemma: Office workers evaluated the large, high and glass roofed entrance halls as the best spaces in the intelligent office buildings, for the sake of working efficiency, however the time spent there was short, in parenthesis can be informed that female workers spent more time at their workplace than men and were less satisfied with it - male workers would have appreciated more workable mobile technology for the sake of their working efficiency. Both made as long hours and as many work trips.

Himanen has hypothesized that tacit knowledge of building designers caused the difference and that the influence of tacit knowledge on the buildings can be tracked by studying the explicit outcome - the intelligent building itself - with the end-user feedback of it.

Many factors can cause the difference between the user feedback from these two building types such as the design offices' or contractors' expertise and preferences as well the way how the buildings are managed or what kind of working climate the occupant companies have. Still, one cannot avoid the conclusion that all those parameters carry with them both explicit and tacit knowledge. Tacit knowledge plays a role, but how?

Knowledge Management Frameworks

Knowledge management takes place after knowledge creation. **Knowledge management** is the process of effectively using knowledge (Davenport 1994). Identifying, capturing, evaluating, retrieving, and sharing all of an enterprise's information assets includes databases, documents, policies, procedures, and previously un-captured expertise and experience in individual workers according to Duhon's (1998) multi-disciplined approach (cf. also Zuboff 1988 on tacit knowledge of workers). Knowledge management efforts focus on organisational objectives such as improved performance, competitive advantage, innovation, the sharing of lessons learned, integration and continuous improvement of the organisation.

Quality Engineering

Quality engineering is a field in production management which has had the user of the product in focus. Total quality management is applicable in any process.

Capability Maturity Model Integration (CMMI) is a process improvement training and appraisal program, especially in software development by Carnegie Mellon University. Under the CMMI methodology, processes are rated according to their maturity levels, which are defined as: Initial, Repeatable, Defined, Quantitatively Managed, and Optimising. Open innovation paradigm for the RTDI in software for real estate is not mature enough as described above for this type of examination, how important it could be (Section "Islands in the Digital Building Ecosystem").

The PDCA (plan–do–check–act or plan–do–check–adjust) is an iterative four-step management method used in business for the control and continuous improvement of processes and products (Anon b, 2008, Figure 4). The PDCA cycle had its origin with Dr W. Edwards Deming's lecture in Japan in 1950 referring to Dr Shewhart's work back in 1939, and is also known as the Deming circle/cycle/wheel, Shewhart cycle.

In the PDCA cycle PLAN means establishing the objectives and processes necessary to deliver results in accordance with the expected output that are specified and documented completely and accurately in an action plan with key milestones identifying goals. DO means implementing the plan, executing the process, making the product. CHECK means studying the actual results (measured and collected in the DO) and compare against the expected results (targets or goals from the PLAN) to ascertain any differences. ACT means determining where to apply changes that will include improvement of the process or product.

When a pass through these four steps does not result into acceptable outcome more detailed development in the next iteration of the cycle will occur.

Objectives

From Main Paradigms

Bergvall-Kareborn et al (2009) conclude that living lab as such is similar in its approach to different open methodologies, e.g., open innovation, crowdsourcing and involving lead users. To broaden this idea of open innovation, a form of knowledge creation, two directions are interesting.

Firstly, the definition of open innovation is referring to the path to market by advancing technology. Open innovation involves a primary end-user involvement alone but comprises secondary and tertiary end-users. There is interplay between the producer and end-user groups. It can be considered as well a BtoB business as a BtoC (business to customer) one.

Open innovation related paradigm in the industrial engineering and management such as service design, co-creation or agile software development methods add on quality or interoperability of design process - further on aiming to add on profitability of business as a consequence of improved methodology.

Secondly, the industrial engineering and management paradigm comprises the RTDI process management concepts. These frameworks originate from various disciplines: quality engineering, software programming and knowledge management theories. They add on quality or interoperability of design process, which on its behalf add on profitability of a business as a consequence of improved product or service, or they lower costs.

Further on, the integration of management concepts is a trend of the paradigm. Correspondently, the total building performance management systems are targeted to comprehend whole building ecosystem and to improve the real estate and building quality.

The research paradigm or the landscape in applying open innovation can be studied from these wider perspectives. This is it, in particular, as agility is a common nominator of the common design process management concepts and those used in modern software development. The iteratively progressing processes dominate in the best cases and have been integrated into end-user involvement in design.

The research is inspired by Dr Mia Toivanen (2013) who emphasised in her speech in a seminar on electrical service provision for regions and citizens:

- the meaning of providers' positive and warm hearted attitudes towards end-users in open innovation and
- the meaning of unconscious needs and desires of the end-users for predictability in co-creation of new services.

Hypotheses

It is hypothesized that the open innovation process of the case study - Digital Living Lab - resembles the flows of more traditional RTDI processes.

The open innovation has a new mental thinking pattern, but the practicalities employ the traditional research methods. It can be hypnotised that the use of traditional user-study methods is enough even for the open innovation when previous studies prove that

- knowledge-based competencies count in relation to culture, situation and leadership style (Koskinen & Pihlanto 2008),
- powerful factors in leadership affect the development of ICT services, as well as, the value placed on attitudes towards users and developers of technology (Toivanen 2006), and
- Himanen's hypothesis that tacit knowledge - difficult to create consciously - is manifested in user feedback of the design outcome (Himanen 2003).

Methodology

Practicalities

The real estate business has been picked as the focus out of the paradigms within the smart city phenomena. This study on knowledge creation within open innovation paradigm draws empirics from a study case, Digital Living Lab which is generic enough to cover the ICT related applications of the smart city phenomenon by applying open innovation real estate property - the venue of human activities. In addition to the source of knowledge the study case provides a research arrangement - a platform for the research.

By comparison is examined the correlation between two RTDI approaches

- a case study of open innovation process in real estate asset and building knowledge management, and
- a selection of knowledge management process frameworks with emphasis on the end-user involvement and iteratively progressing processes.

The tradition and latest development in the paradigm on knowledge management will be compared. How similar the open innovation method within the case will be with the knowledge management methods described by the selected frameworks? Do methods with very similar ideology from various time periods match? Rough estimations are made how the frameworks match - a first idea of match is targeted for later detailed research.

The study draws as much from empirical knowledge in the open innovation process for smart technology of the study case, as from the selected knowledge management frameworks. It will be studied how well the technologies applied within the study case represent the principles of

- the service design requiring methods and tools to control new elements of the design process, such as **the time and the interaction between actors** together with the most traditional methods used for service design, and
- the co-creation in realisation a form of business strategy that emphasizes the generation and ongoing **realization of mutual firm-customer value.**

Narrative Methodology

To study and understand the open innovation concept of the study case called Digital Living Lab the narrative method has been employed by story-telling. The history of the RTDI of Digital Living Finland Oy has been documented with the key milestones and according to the phases of the RTDI process.

The nature of the knowledge work process has been examined by tracking tasks together with methods of the Digital Living Lab for creating the first version of the proof-of-concept of the application. The process of knowledge creation by knowledge transformation in open innovation will be described by studying how the theory of knowledge transformation apply into the design process of the case of Digital Living Lab during the open innovation process.

Theoretical Frameworking

Theoretic concepts are mirrored on empirical data from the Digital Living Lab methodology. A common nominator in modern software agile development is not only the emphasis on the end-user involvement, but the iteratively progressing processes which influenced on the pick of the paradigms to be studied. The consulting activities based on these frameworks have not been part of this study.

Deductive reasoning (linking premises with conclusions) is used. The comparison is based on
The concepts as follows:

- Agile Production Cycle,
- The PDCA cycle (plan–do–check–adjust), and
- The Nonaka-Takeuchi learning cycle.

Previous scientific findings on knowledge creation:

- knowledge-based competencies (Koskinen & Pihlanto 2008),
- the factors of leadership and attitudes affecting development of ICT services (Toivanen 2006), and
- The Himanen's hypothesis of tacit knowledge in building design which manifested in user feedback of the design outcome, which was.

The Study Case

The study case is the digital knowledge management of a real estate property provided by Digital Living Finland Oy established in 2008. The Digital Living generic software is applicable in several fields.

The company is a privately own company on the knowledge management software provision and related customer applications (www.digitalliving.fi). The first group of targeted clients of the Digital Living knowledge management application are the real estate owners and the building service operators, and the visitors and occupant of buildings. The system is used to run the businesses taking place in the buildings and to manage the assets of property - an individual house or a stock of buildings.

The open innovation concept of Digital Living Finland Oy is called the Digital Living Lab. It has evolved organically within the working team since 2008. The Digital Living Lab holds the European Network of Living Labs membership (ENoLL, http://www.openlivinglabs.eu/livinglab/digital-living-lab). The second version of the proof-of-concept the Digital Living knowledge management application is under way. This study deals with the beta version 1.5. The RTDI has formed the main share of the company activities by such projects as: confidential product releases, Houser project of "the User-Driven Housing Business - Knowledge, Stakeholders and Current Research and Development Projects in Finland" (2013), or "Housebook World domination plan - beta" (2011-2012). The company has been a partner of EU FP7-funded research project REGIONS-2010-JADE (www.jadeproject.eu).

The experts in real estate business, computer and social sciences have carried out the work on the study case of the Finnish Nature Centre Haltia (www.haltia.fi). The Finnish Nature Centre Haltia and Digital Living Finland Oy have signed a contributor-level agreement on corporate partnership. It is an action within the open innovation or the co-creation paradigm. Digital Living was selected as Haltia's partner because this makes it possible to implement a novel system of smart real estate management. The partners will collaborate in developing and building the first public building in the world that employs a genuinely digital knowledge-based management system. This uniquely ecological nature centre will also become a smart building that can communicate with its users in a new way. Nature experiences and energy efficiency are enhanced by linking Haltia's multi-faceted technology solutions into a single operating system.

In the Haltia building the end-users are the professionals who run real estate business. They are asset managers, facilities managers and personnel who provide occupant services and take care of the building service maintenance. Knowledge on buildings and organisation is managed with connected applications: space, system, people and stock. Instead of operating on spreadsheets the company's resources and operations are led in real time - anticipated and prepared.

The Digital Living intelligent technology gathers information about people, organisations, spaces, products, devices, systems following the concept of the IoT. It makes links between the gathered data after the needs of decision or activity processes. The application is situation and event-aware. Linked data technologies are employed to tackle the interoperability of the software provision and the related customer applications. It connects the data from real world items with relevant Internet data sources. The knowledge management software of the study case takes into account also the roles that a user could take. One gets an easy and secure access in one's own role to information.

As described in the section of the "Islands in the Digital Building Ecosystem", it is not known that the Digital Living knowledge management application has yet a competitor and thus it is a radical product, it is a product without established markets. It has been figured out during the discussions with the leading professors in the computer science and leading companies in the field in various parts of the world. However, the subject is very topical right now.

Concluding Results

The key findings and lessons learned are listed by phases of the open innovation process during the RTDI work in the Digital Living Lab (cf. also Himanen 2012). The first versions of proof-of-concept of the Digital Living knowledge management application for owners and operators of smart real estate property were developed (beta 1.0-1.5).

Tasks of the RTDI of the Digital Living Knowledge Management System in the Haltia Case

The working principles of the open innovation have taken place in various parts of the RTDI process as shown in the Figure 2. The phases of the RTDI work are: Business Planning, Systems Design and Concepting, Programming, Implementation and Commissioning.

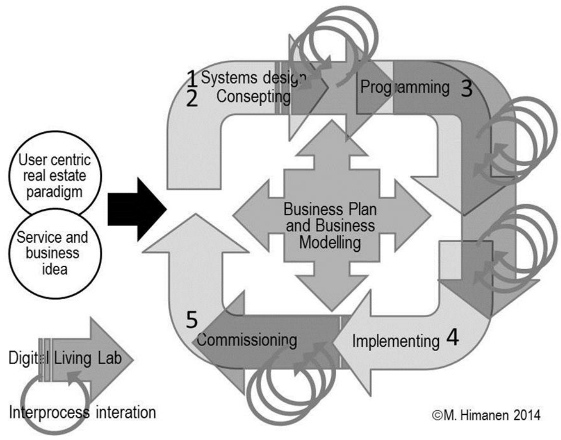

Figure 2. The phases of the open innovation process for the Digital Living knowledge management application called the Digital Living Lab. Each phase of the RTDI process of Digital Living Finland Oy is iterative. As a whole agile RTDI process comprises inter-process interactions.

They can be shortly summarised that

- Business Planning phase included planning of the idea and concept of the radical service and the financial planning of the company (do not concern the study case),
- Systems Design and Concepting followed concerning the service but it took place also the RTDI project proposing for financing,
- Programming took place by personalisation, linked data, and by role-based, event- and situation-aware programming schemes,
- Implementation took place at the Haltia building, and
- Commissioning started after the opening the museum in May 2013.

Business Planning

The product and business ideas originate from 2008 and created in a small start-up owned by the entrepreneur. From the very beginning the product idea has been tested by meeting potential clients and end-users. In the first place, the ideas were expressed by a semantic presentation before the programming took place. The business and product plans evolved when applying funding and proposing RTDI projects. Applications were sent to both national funding organisations and European Commission (EU). End-user involvement has been highlighted in the EU calls of research projects.
It took some time to find the correct wording - use of correct terminology - for the very new idea of a radical service product in real estate business which can be characterised as traditional. That was the case as well with pitching as with longer sales occasions. **The thinking behind the Digital Living knowledge management concept is holistic covering the whole building or even entire living ecosystem. It seemed unfamiliar although each time the message was focused on the core business of the potential client.**

The Digital Living knowledge management application comprises the sophisticated software and related customer application. Experts in client companies seldom possess the degree in more than in one discipline. Even if they had a multidisciplinary education, their job is focused and work time spent on certain tasks. That could have caused communication problems.

However, the communication problems were solved after a relative large number of meetings - suddenly all potential clients and end-users started to welcome the idea. Interestingly, for time being (2014), both venture capitalists and business angels have found the most fascinating the generic service concept of the Digital Living knowledge management. It can be concluded that it has been even better ground for financing than the actual heavy financial calculations on profits. The clients of the company are satisfied while the generic and role-based approach allows the clients use the application after their preferences. They are not bound to in advance dictated algorithms.

Bergvall-Kareborn et al (2009) conclude that the key **element in the user empowerment principle is to base innovations on humans' needs and desires, and to utilise the creative power of user communities. That is a key element in the Digital Living Lab as well.** However the expression of the humans' needs and desires can be understood to refer to such end-user groups as citizens or consumers - anyhow individuals alone - the primary end-users. That was the starting point in the development of the Digital Living knowledge management application. However, it turned out that this approach did not work in all cases. **It was found during the business planning and consepting that all of the potential clients were not necessarily convinced on a service product based on the end-user approach with citizens or consumers as users. It turned out to be too radical for the representatives even in the BtoC**

business. They were used to see themselves rather in the provider's role.

A conclusion is that **the working team experienced the communication with the end-user to deepen the mutual understanding into the level where it is easy to the end-user to realise the content and properties of such a radical product** as the software for digital knowledge management system and related customer applications.

It was not fully confirmed by the study, although it seemed obvious, that the finding of emphasis on the provider's role corresponds to the conclusion of the Bergvall-Kareborn et al (2009) who say:

> *"The methodology stresses user involvement in real world contexts. However, we find that there still is much work to be done before the concept design process truly meets the vision of taking place utterly in the users' real world contexts throughout the whole innovation process, as well as being truly user-driven."*

It is ideal if the service provider can serve either its client alone or take into account the primary end-users who are the service provider's client's customers.

However, the product idea could not be limited too much despite the end-users were listened and their input taken into account. The Digital Living Lab concept has from the very beginning kept the expert knowledge as important as the primary end-users' knowledge of their preferences. The problem of contradictory between the wide business idea (of all sorts of end-users in various roles) and the limited end-user preferences was solved by keeping the core of ICT with generic algorithms but extending the technological concept by adding role-based properties in the ICT application. The user-requirements can be satisfied from several user groups' perspectives when the system allows one user take several roles. For example a lady can act in the role of an engineer and that of mother, and still use the Digital Living knowledge managing at work and at home or where in motion.

Co-creation took place. The original idea of the entrepreneur or the company was respected although concept was advanced by feedback from potential end-users.

Systems Design and Concepting

Systems analysis and concepting was based on thorough identification and listing of the items in real estate and facilities management. Mind mapping was used. Systems thinking merged the knowledge that had been adopted at university, at previous work and during the discussions with end-users. Scientific knowledge of indoor environment and intelligent building technology was added to that in real estate management.

All professionals in the real estate management share common content of scientific paradigm. However, on the basis of the university education it was not necessarily self-clear, what the end-user interviews revealed among experts practicing profession. Relatively little verified knowledge was used to run the building property - sometimes an asset of high value and a property or facilities management business with large personnel. Used digital tools without any artificial intelligence listed and summarised data.

Despite the currently used software in real estate business has no links to the ICT tools for the building design, the potential for integration was found. However, the islands of applications are becoming mature enough to be compatible with the latest computer technology - the adoption of the cloud technology forming an integrating key factor. Many solutions - such as BIM or building automation - are catching up, but some of the applications need to be replaced with new software due to problems in interoperability.

Interviews among the potential customers and later the implementation of the system into the Haltia building draw the picture of the various roles that need to be taken into account in software provision for running real estate. If the end-users do not form a homogeneous group, the same goes with the system provider's experts. Expertise from various fields is needed to result into the outcome with a full set of properties after customer needs.

Implementation Phase

The beta version was programmed by the senior and young experts and thus combining the latest knowledge of computer science and proven practicalities in creation of the algorithms which were based on role-based personalisation, event- or situation-aware programming, and the concept of Industrial Internet.

Co-operations among experts in technology dominate any implementation phase, because technical installations are considered rather as provider than end-user-oriented. However, at Haltia - the Finnish Nature Centre, the smart building concept does not refer only to intelligent equipment, but in the first place to the interaction between the facilitation and its users - the visitors and occupants. In the modern ecological building user-requirements generated ideas of interoperability. **The technically sophisticated installations have been integrated to serve best its users. Co-operation among the providers can be considered a form of open innovation**. It was created:

- A nature centre which can be run as a show case for visitors, meaning that nature experiences or ecology and energy efficiency of building technology is shown in a manner that fascinates the visitors, e.g. the numbers with kWhs (kilowatt-hours) were replaced with easily comprehensive hints of energy consumption,
- The Haltia building's multi-faceted technology solutions were linked into a single operating system which is best able to enhance the performance of each individual system and which simultaneously interoperate based on user-requirements of both visitors and occupants,
- Daily occupant operations are easy to run thanks to the integrated operation system. For example, the occupants will have a clear view of everything that is going on in the building. The flow of information has been significantly improved and unnecessary work prevented.

The Digital Living knowledge management application which was implemented into the Finnish Nature Centre Haltia can be best described as follows. The building managers operate the FM and building automation (running building services) linked to the system, but the other occupants have access to it in their roles too, as any other stakeholder if needed. A core of the FM in a nature centre is the exhibition facilitation. The functions of display equipment play an important role. In addition cleaning, restaurants, security and maintenance of building service equipment are linked to data of solar energy and from weather stations. Furniture and movable piece of property along with their product information have been digitalised and linked in.

Commissioning Phase

In the commissioning phase when users will be trained to use the software and the user feedback will be gathered. The intensive communication started right after the doors of the nature centre were opened to the public and the operation began. **The experts in technology and in social psychology worked together with the occupants.**

Such difficulties were found that

- The communication was emotionally difficult for the experts in technology. They almost fear to face the user feedback revealing the weak points of the technology they had created according to their best expertise. That could made them prevent meeting end-users. Expectation of disappointment was stronger than that of applause. One might need to give up ones great ideas. Suggestions for corrections tend to mean extra workload. Toivanen (2013) also had found cases where the primary end-users have not been consulted at all. Asking has been avoided and experienced embarrassing or thought to be troublesome.
- Social scientists are better educated to face people and their troubles. However, it is not an easy task for them either to persuade occupants in an overloaded working organisation to start using a new unstable software application on top of those many already in use. Honesty is appreciated and Finns tend to be quite straight forward in their behaviour in that kind of situations although in a small country it is not always wise. In the study case the situation was hectic due to the opening of a brand new business of a nature centre.
- Personal characters of an expert coming from any field counts. As well, it helps if one gets timely support from own work team or do not need to face the end-users alone which is not necessarily often the case in the innovation intensive small start-ups or spin-offs.

On the other hand it was found such positive points as

- Occupants benefit mentally from the attendance of the service providers' experts while they know someone cares not only charges.
- The learning process is smooth going if the service provider allows time to the end-users to adjust themselves to use the new operation management tools and there a friendly person whom to ask in person.
- Realising by learning that the software tool kit will assist ones work remarkable makes the end-user satisfied, but also encourages the service providers.

Methods applied in the commissioning phase at the Digital Living Lab are:

- The process of developers and end-users co-work bases on respecting each other's expertise and experience on the system's operability.
- Sharing knowledge on the user feedback alone is not the only way of progressing but also informing of the grounds for technical solutions.
- Communication and sharing takes place on equal level in every aspect. It is not necessary to convince anyone of anything. Over marketing or underestimation are not needed – could it be said that manipulation is not at all allowed.
- A good practise has been created when proceeding from solving one detail first and all the others that after (cf. agile design with small software releases with rapid cycles, (Abrahamsson et al 2002)).
- Making acquaintance and friends with the end-users by being interested in occupants' work and spending time together during the breaks and at meals. Trust is built. Friendly communication and common humour can appear.
- Two things makes it possible for the software provider's representatives to defend their inner peace and face the users who just recently or repeatedly express their opinion with strong negative emotional expressions are:
    - Trust on the ability of the product to assist the occupants in their work after they have made acquaintance with it.
    - To respect in one's professional skills in social science or in technology helps to have enough strength.
    - Knowing that pointing out mistakes and lacking properties helps to advance the software, which is a benefit for both the user and the provider.

The resources spent on the Digital Living Lab will be paid back by

- The true user satisfaction gained from the added value of knowledge manageable daily operations of the user.
- Reaching quickly the positive outcome instead of constant correction due to lacking RTDI and misunderstandings of the users - in worst case the software will never work properly.

Mirroring the Digital Living Lab on the Knowledge Management Frameworks

Match between Agile RTDI at Digital Living Lab and Agile Production Cycle

The open innovation of the Digital Living knowledge management application has been described according to the Agile Production Cycle (Figure 3). The tasks of first iteration cycle have been identified together with the outcomes of each task.

The Agile Production Cycle considers that if a product or a service is not acceptable then a cycle is continuing with corrections without market release. When applying open innovation, it can be agreed between the provider and its client that the last phases of the RTDI will be finished together as done in the case of cooperation with the Finnish Nature Centre Haltia and Digital Living Finland Oy. The property owner and the occupant companies in the Haltia building are very open to new and radical ideas that Digital Living knowledge management application has realised in the building. They want to be the first to apply new ideas.

The Digital Living Lab has employed the concept of co-creation as a business strategy. It emphasizes the generation and ongoing realisation of mutual firm-customer value that the co-creation process will bring with it (Prahalad & Ramaswamy 2004, Section Co-creation and Co-design).

The Agile Production Cycle is good for describing the intercompany processes. It is lacking in taking into account the interaction between the end-user and service provider coming from different organisations.

However, the Digital Living Lab methodology will be more completely described when the concept of co-creation is added into the description. A hypothesis can be identified for future research that a sophisticated integrated knowledge managing concept for open innovation is needed.

The integration of management concepts are evolving and the subject is topic in science. The short literature review among open access papers was made. It did not hit on research with results that are applicable in integrated management concepting for this open innovation case. The research question of integrated knowledge managing concepts for open innovation is open.

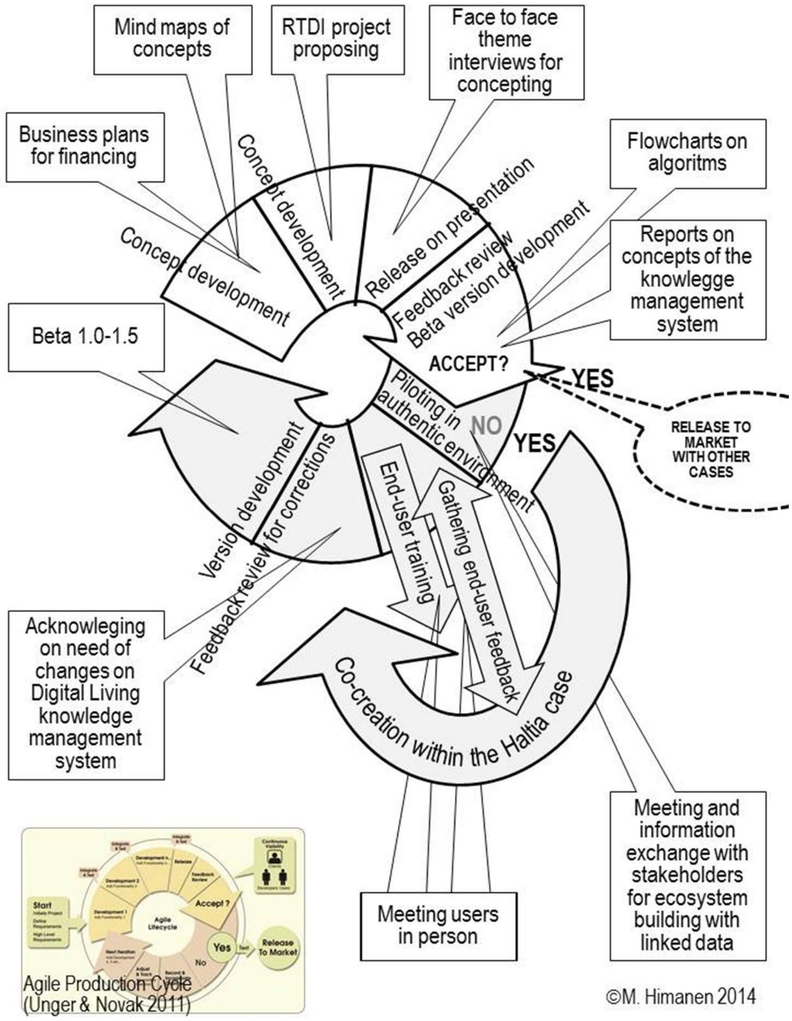

Figure 3. The RTDI process of the Digital Living Lab described according to the Agile Production Cycle framework together with the paradigm from the Co-creation framework, which was needed to accomplish the description of the agile open innovation process at the Digital Living Lab.

The Agile RTDI at Digital Living Lab and the PDCA cycle collide

There is no full match between the description of the open innovation phases of the Digital Living knowledge management application and the concept of the PDCA cycle although both aim at added quality of the product or in this case the ICT service (Figure 4). One cannot avoid recognising some resemblances with the waterfall pattern within the PDCA method.

The user involvement in the Digital Living Lab takes place very early in the process and the corrections need to be started already in the concepting and programming phase, which correspond to the DO phase in the PDCA cycle which suggests just to identify and to chart lacking's not correct them right away. Merging the DO, CHECK and ACT phases into one as shown in the figure 4, results into a closer estimation of the match between these two methods.

The repetition of the PDCA cycle as such frequently seems to mean that the whole process of plan-do-check-act needs to be repeated change after change even if the change is small. **This could be healthy for realising the influence of the minor changes to the whole of the software. On the other hand, it might cause extra work in vain**.

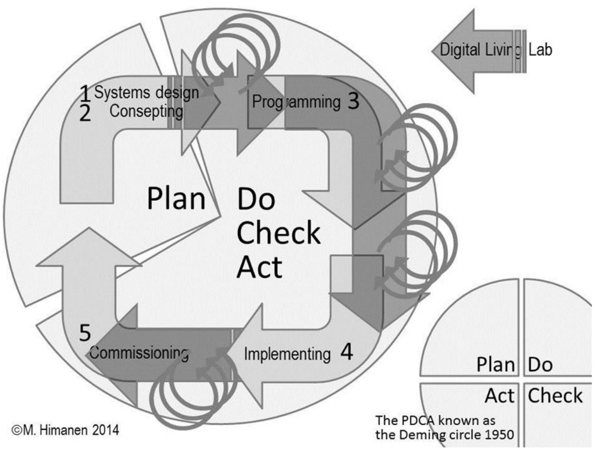

Figure 4. The open innovation of the Digital Living knowledge management application on the PDCA cycle (Section "Quality Engineering"). As no complete match between the PDCA cycle and the Digital Living Lab methodology existed the modification of the PDCA cycle was found for the closest estimation as shown.

A hypothesis can be identified for future research. The problem of integrated knowledge managing concepts for open innovation will need research on modifications of the previous concepts.

Knowledge Creation in Active Work

Toivanen (2006) found the large influence of attitudes and leadership style when applying ICT in service provision in municipalities. Meaning of them can be tracked down also from the Digital Living Lab culture.

The Digital Living Lab draws from the teaching in university, which has both explicit and tacit knowledge. In knowledge work and in knowledge working groups both explicit and tacit knowledge are shared. Explicit knowledge has been mainly delivered via study books and electronic media. Tacit knowledge can be articulated during meetings and when working together in person. It is shared when attending lectures or within tutoring and workshops. As well carrying out work individually or in groups can have a strong effect on tacit knowledge sharing although the explicit knowledge might guideline.

The user-oriented mentality in the Digital Living Lab is originated from the mind-set of the establisher of the company (Figure 5). He has found himself as best when he had the chance to explain and share ideas with his clients, users or executives why they need the ICT application, how it is best used, what benefits it brings with, etc. He has not only adopted this attitude at university, but he has already quite young adopted ideas of innovation when worked with his parents: an architect with futuristic ideas applied in organic architecture and a scientist whose work has focused on end-user involvement in smart building.

As the start-ups often grow first with friends and family, the first fellow workers and partners have shared this attitude of thinking first the customers' benefit without forgetting ones enjoyment of inventing best expert knowledge into the solutions when drawing the application. The entrepreneurial thinking is familiar with them too.

The sharing of tacit knowledge can be recognized in the end-user feedback of the outcome within the work of Digital Living lab (Figure 3) as the findings of Himanen has proved earlier (2003). The maturity of the Digital Living knowledge management application does not allow detailed verification of the feasibility of the outcome. It is interesting though to be back with such as study later. As being a unique service product of the type in the world so far there cannot be found any reference value for verification. However, it can be stated that the market releases have proved of high customer satisfaction with the wow phenomenon. This was first found when the director of the Haltia Nature Centre trusted on the Digital Living concept - on the basis of a semantic description and the start of programming beta 1.0 of the software became possible. His decision has been confirmed after the system installation by the building service personnel, both the white and blue colour workers satisfied with more effective method of work. This has been found also with other customers, after next contracts were agreed.

The Digital Living Lab is a Ba (cf. Nonaka 1998) for knowledge creation comprising both tacit and explicit knowledge. When Digital Living Lab has developed organically the situation has been such that tacit knowledge has cumulated by individuals as a result of active work into knowledge-based competences (cf. Koskinen & Pihlanto 2008). Further on, tacit knowledge is culturally assimilated in such a project based company as Digital Living Finland Oy having core business in digital knowledge management. Thus, the leadership style has been able to create an organisational culture which well applies open innovation.

It can be concluded that the respecting of end-users and related work within the Digital Living Lab originates from the tacit knowledge in entrepreneurship and in end-user-oriented attitude of the founder of the company and the first co-workers who have shared the same spirit.

Knowledge Creation by Knowledge Transformation

The process of knowledge transformation in open innovation process at the Digital Living Lab has been identified by finding correlation between the phases of the work within the lab and the modes of the Nonaka-Takeuchi learning cycle (1995). The aim for the knowledge worker is to apply both explicit and tacit into the design, or any other knowledge task.

The expert knowledge of the working team, including the entrepreneur, comprises both tacit and explicit knowledge. It is learned either at the universities or at work. During the systems design and concepting phases both tacit and explicit knowledge will be shared among the team members.

In socialisation the aim for the knowledge worker is to find ways to collect tacit knowledge of personal talent during the face to face communication. **The knowledge sharing process within the working team can be quite fuzzy during the socialization mode when tacit knowledge becomes only tacit. Tacit knowledge is shared while working as a team**. This phenomenon has been explained with the concept of Ba (Section "Knowledge Creation in Active Work"). Personnel of Digital Living Finland Oy sat together around the table (Figure 5).

Figure 5. A part of the team members in summer 2013, in picture left Aleksi Kohonen, Ida Korhonen, Timo Varjo and Pirkka Frosti (Mervi Himanen behind the camera).

Sharing knowledge creates new tacit knowledge. New ideas start to appear or new type of "touch" to the subject or work will be obtained. An expression in everyday language: "I need to think about it", can be considered as reflection of the process of accepting or considering team mates' suggestions.

As well, the systems design and consepting phase covers the externalisation mode transforming the tacit knowledge to explicit knowledge. Each individual in working team will transform also her or his tacit knowledge into explicit, when expressing orally her or his expertise and professional experience. It will be manifested in the idea and concept of the product either in acceptance or deny or new modification of the idea appears. The previous knowledge (obtained during education and previous work) has been merged in to the new. Brainstorming starts to create visible results. In the case of Digital Living Lab the presentation of the idea and product concept on various media appeared as an outcome of externalisation mode.

It can be presumed, however, that **the way of organizing the mind maps transforms also the**

tacit knowledge into explicit. The knowledge creation lingers still also in the externalisation mode. Mind mapping can be a two edged process where check lists and guidelines for example can help to convert the sentences and symbols into a detailed and organized form. But, it is also inner knowledge creation by the person or group who draws the mind maps. The same happens within semantics. Meaning is turned to thesauruses or ontologies, figures with words on shapes or symbols or photos, etc.

Soon after, the result of the idea and concept was put into the form of mind maps they were shared with the potential clients by face to face interviews. Their tacit knowledge was translated into a readily understandable form, explicit knowledge via externalisation.

During the interviews among the potential clients the knowledge sharing of the product ideas was focused on combination mode, while the level of communication was dominated by explicit knowledge chaired by the presentation of the service product ideas. However, the expert knowledge of the interviewees comprises also both tacit and explicit knowledge - externalisation need to take place, but cannot be argued by the deductive reasoning which has been picked as the study method for this study.
The combination mode can be considered to be quite clear in the implementation phase when the technical expertise - which has expressed clearly and thus it is implicit - was combined into a digital ecosystem. The explicit knowledge is shared within the Digital Living Lab via conversations, documentation and installation as well on paper as via telecommunication during the implementation as a combination mode.

The lessons learned during the commissioning phase where the internationalization mode took place has been summarised in the Section "Commissioning Phase". Learning and adaption of new knowledge occurred during training and feedback gathering and corrections.

Both the fiendly knowledge sharing and the anger towards the unstable software carry with them tacit knowledge which is relevant or not to the system development. Open-minded listening is needed that knowledge from both the expert and the end-user will be deepen enough and taken into account if needed.

Himanen foresees that it helps in being open to others' ideas if one knows own needs and desires and do not suggest to others only such solutions that make the designer or the provider happy - sharing them is preferable only if they provide expert knowledge to the end-user making she or he more able to consider if suggestions can be applicable in the end-user case.

Consequently then personalisation of the application will rather correspond the needs and desires of the end-user than those of the developer. However, this is a two-edged sword, because the end-user does not know everything what the application is able to perform. Then the learning process by co-creation is the solution. Developer learns from the end-user and the end-user from the developer as done during the commissioning phase.

Himanen foresees also that it helps in adapting the application according to the outcome of the co-creation and after being open to others' ideas if one is able to give others all the best. Guaranteeing one's own living is normally the best motivation in human activity, not necessarily giving to others.

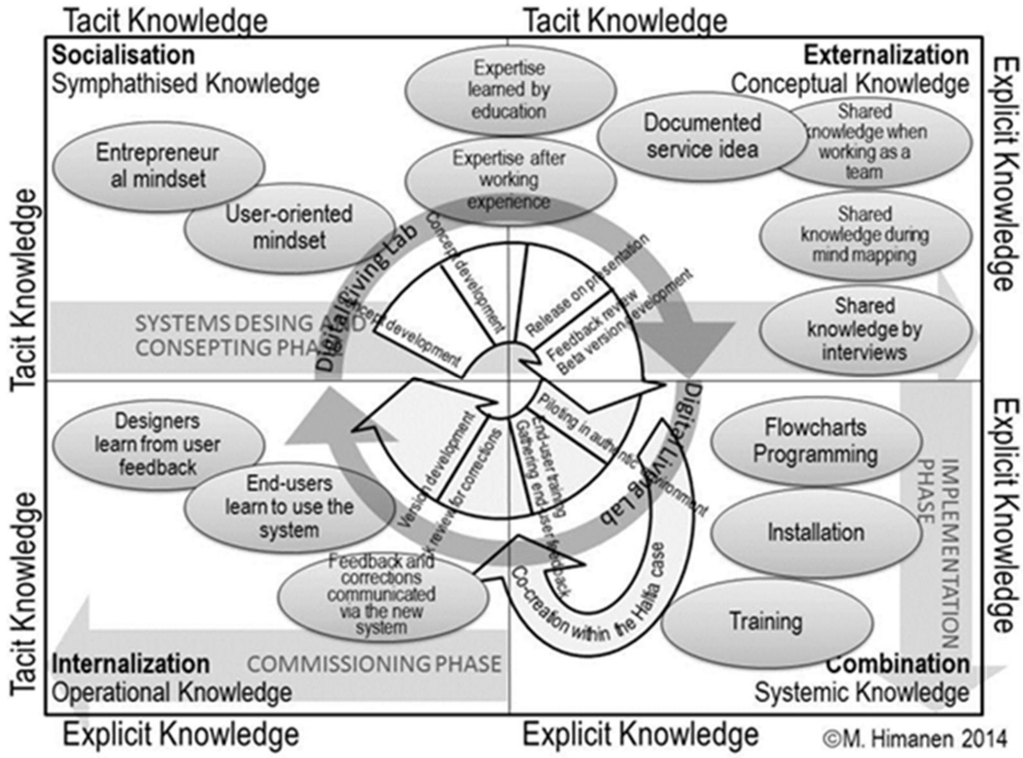

Figure 6. Knowledge evolution at the Digital Living Lab in the context of the Nonaka-Takeuchi Learning cycle.

Digital Living Lab Equivalents to Open Innovation

Toivanen (2013) emphasised the meaning of providers' positive and warm hearted attitudes towards end-users and the meaning of unconscious needs and desires of the end-users in predictability in co-creation of new services. Similarly, the Digital Living Lab respects the working team and acts towards the stakeholders outside the company.

The Digital Living Lab can be described to have mental grounds in the RTDI practise of open innovation. Correct attitudes are employed towards all the stakeholders within the whole RTDI process. The professional ethics carries similar values. In addition to the principle of respecting others, all tasks within RTDI are kept valuable and taken care accordingly. The team is hungry for deep understanding of the completely listed items and the interoperability in any application when linked data will be used by the end-users in their knowledge management tasks such as managing daily operations of a nature centre or a mall and the occupant companies they have as their clients.

At the Digital Living Lab the idea of open innovation has been understood and implemented as Chesbrough (2003) originally defined it. Contacting end-users is employed as a path to market. External ideas are merged into internal ideas to advance the technology and related application on it. The IoT (Internet of Things) technology is applied. When rebuilding the real world items and actions into web or cloud to be used by people in real life context, every smallest issue need to be taken into account - it is building brick by brick, detail after detail. It is the hard core of IoT technology and in the hard work in implementing it. Linked data technology multiplies the consepting to unlimited number of relations between the item, its objects and their definitions. Criteria and indicators of the processes are needed for creation of the algorithms for decision making. **The working culture and ethics count. Patience and trust on ones visions and expertise help**. Good things come to those who wait. Every innovation takes its own time - despite in some connections certain time limits have been considered wise in any case - with a simple and a complex one.

The Digital Living Lab is a holistic approach to the RTDI of the entire building ecosystem and for the entire building life cycle - from the feasibility study and planning to the operation phase up to demolition if needed. This is potential building towards smart city, the original business idea.

Concepting and tooling can be reached up to the linked activities of occupants. They are given the chance to take various roles after their needs and desires. The focus is not only in the understanding the customers' problem, but provide tools for solving them to enable smooth going and profitable real estate business.

The RTDI work of the Digital Living knowledge management application is carried out by the agile RTDI method applying iterative spiral model in sequences along the process. Testing and end-user involvement occurs several times in various phases of the process (Figure 3). Iterations of synthesis and analysis take place. Synthesis uses creative thinking and locks in novel ideas as new versions of proof-of-concepts evolve during systems design and concepting. Analysis verifies the selected solutions, added values, etc. during the commissioning phase in particularly and always when the externalization mode occurs.

Expert knowledge and end-user feedback are as important in the RTDI. **The deep understanding of the dialog between the user and the developer and the emphasis on solving the end-users' problem with expert knowledge are keys to success**. The feasibility of the innovation is evaluated against the interests and social expectations of a large variety of end-users: citizens, consumers and business owners and operators. All stakeholders participate from various sectors: business, academia, public sector, third sector, financing. They represent various disciplines: technology, psychology, social sciences, law, ethics, aesthetics, media, etc. The new versions of proof-of-concept follow each other's both according to end-user feedback and the expert knowledge. The principle of design-for-all is applied.

During the process so far around 300 of end-user organisations have been met. They form the group of potential clients. Knowledge of the market potential and user-requirements has started to cumulate simultaneously. Always a systematic knowledge exchange has been organised and followed carefully. The Finnish business landscape of real estate business and software provision has been mapped - without forgetting the representatives from co-operating fields as financing and banking or construction who have been met. Co-operation has reached other countries as Sweden, Italy, UK, France, Turkey, and Middle East. The Digital Living Finland Oy is born global and turning international.

The open innovation at Digital Living Lab has developed organically drawing from the skills of the personnel at Digital Living Finland Oy, which is obtained by studying, via working experience, by meeting and talking with professionals. Traditional methods for user-studies are used. Knowledge gathering takes place as well in concepting and agile programming phases as during the commissioning. The success follows by applying proven methods correctly even if they are simple.

The work is carried out at the Digital Living Lab following similar ideas as Toivanen (2013) has emphasised: instead of employing the ideas that experts know best, the end-user views need to be respected, taken seriously into consideration, and the interaction need be cordial and warm between end-users and service provider. She keeps it important that the delivery - a product or a service - is the answer to the true needs and user expectationss and not those the provider has extrapolated. Commitment and transparency are keywords when targeting win-win-win situation. Constant learning equals for staying hungry to do better. The industrious and careful working ethics was already discussed in the beginning of this section when the follow up the IoT principles have been touched.

Toivanen (2013) recommend be wise enough to be able to avoid certain issues. It is quite common to ask how the existing product or service could be improved or how good consumers evaluate it but not asked is there an alternative way of solving the problem or to serve the purpose of the existing product, as done within Digital Living Lab. **Even if asked properly, afterwards the response might not been taken into consideration. Misunderstanding occurs**. The answers are interpreted incorrectly - especially the user experience. Or the end-users do not know what is asked while they do not know the latest version of the product or it is not all familiar. **Users might consider that what is asked is not possible.** One may neither patronise the users nor neglect the input.

Conclusion

If open innovation is similar in its approach to the other methods of innovation was examined. The frameworks of RTDI process originated from various disciplines: quality engineering, software programming and knowledge management theories was examined. All of them aim to a qualitative outcome of the design process. The common nominator of all studied knowledge management approaches to innovation process had emphasis on the end-user involvement and iteratively progressing process.

The real estate business has been picked as the focus out of the paradigms within the smart city phenomena. The work has stated from the building sector - the venue of human activities. The paradigm of real estate business has developed fast during last two centuries. In parallel, the need of taking end-user involvement in the process has become obvious. The needs of the building owner, the secondary end-user, have been in focus. This study focus on how the various stakeholders cooperate in innovation. How the primary end-users feedback on needs and desires count.

This study on open innovation draws empirics from a study case, Digital Living Lab which covers a part of the ICT related applications of the smart city phenomenon by applying open innovation. The RTDI process of the first proof-of-concept of the Digital Living knowledge management application serving real estate owners to manage their assets and FM operators to run their business in managing the property has been the case.

The studied case, the Digital Living Lab is a holistic approach to the RTDI by open innovation covering the entire building ecosystem. It reaches up to tooling the activities of occupants. It gives the occupant the chance to link the activities after their needs and desires. They can operate the Digital Living knowledge management application in the role which is best for performing the task in hand.

It was hypothesized that the open innovation process in the agile software development resembles the knowledge flows of more traditional RTDI process concepts. However, the selected previous knowledge managing models did not match with the case of Digital Living Lab methodology, but the integration of management concepts for was a solution. Adjusting them was the other way of finding the match.

The research question of knowledge managing concept for open innovation was opened for future research:

- A sophisticated knowledge management concept for open innovation is needed.
- The modifications or integration of the previous concepts offer a starting point for the problem solving of the creation knowledge management concept for open innovation.

The deep understanding of the primary end-user needs and desires is crucial. That is it, in particular if the application is personalised. The knowledge management software of the study case took into account also the roles that an end-user could take. The focus is not only in the understanding the customers' problem, but provide tools for solving them to enable smooth going activities or profitable business.

When applying open innovation, the service idea dictates the goals for algorithms and other technical methodology. Event- or situation-aware programming and linked data technologies were employed to tackle the interoperability in the software provision and the knowledge management of related customer application.

The open innovation has a new mental thinking pattern, but the practicalities employ the traditional research methods. The study case of the Digital Living Lab proved the co-creation to be a powerful tool even when using basic user-study methods for gathering input from true users by living lab. Co-creation has served its purpose in fulfilling both the primary and secondary end-users' preferences.

The team at the studied company experienced that the communication and co-creation with the end-user deepens the mutual understanding into the level where

- it is easy to the end-user to comprehend the content and properties of such a radical product as the software for knowledge management
- the business idea was developed mature enough to serve with personalisation built in the customer application,

- the added value of the application became obvious because the digital knowledge management was realised to enable users to act after their preferences, in the commissioning phase in particular,
- the trust on the service idea was strengthened although or because co-creation revealed weak points that needed further development
- the fragmented structure of the digital building ecosystem was revealed and due to it the interoperability of facilitation was increased.

As mentioned following thoroughly the traditional user-study methods can guarantee the true interaction between the user and the service provider. Respective and warm-hearted attitudes between the key operators made it. In addition, the respective attitudes towards the work in hand counts. Both providers and users troubles cannot be saved with open innovation. Open dialog between the user and the developer which respect both parties with their strengths and weaknesses is a key to success - listening with open mind and acceptance, in particular. However, the communication with the potential clients and customers is challenging. The methodology of how to face the customer needs and desires is lacking in the RTDI practice of open innovation. The Digital Living Lab has started to figure out means to manage the dialog better. Trust on the qualities of the innovation and the expertise of the personnel makes the difference. As well, making acquaintance and friends with the end-users makes co-creation easier, especially, while also lacking qualities of the innovation need to be solved face to face.

The first estimation has been drafted of applying the knowledge management theory in the agile design phases. The correlation between on knowledge transformation modes and the knowledge creation phases was tracked down. It can be concluded that much of the Digital Living Lab culture originates from the tacit knowledge in entrepreneurship and in end-user-oriented attitude of the founder of the company and the first co-workers sharing the same spirit.

To be very precise it need to put that as it is not a norm among the secondary users to accept the primary end-user-oriented approach, the externalisation mode concerning representatives outside the company was not that intensive than what it was within the working team during the knowledge creation phases. To be clearer it can be put that because all providers do not respect the end-user needs the company using open innovation methodology cannot import ideas from its clients' end-users in full extent.

However, in the commissioning phase the knowledge transformation modes were intensive among the installators of the technical facilitation, as well as, between the digital application provider and the stakeholders in the Haltia nature centre.

All tacit knowledge of the thinking behind this paper might not have transformed into explicit which is, however, the purpose of this task of writing.

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Acknowledgements

The authors would like to thank the personnel of the Finnish Nature Centre Haltia and all the other stakeholders involved in the operation of the centre. Especially important it has been that Nature Centre Director of Haltia Timo Kukko trusted on the Digital Living knowledge management concept and that the patience of Exhibition Technician Seppo Kivenniemi has allowed the commissioning the needed space. They have been convinced that the natural world is best respected by creating an environment that is meaningful to visitors, one that speaks to you and withstands the test of time. The courage of Haltia's creators has made it possible to generate completely new IT expertise in Finland. Also partners responsible for the ecotechnology of Haltia have shown great support both in implementation as well as during the commissioning.

The authors would like to thank their colleagues Janne Laukkanen, Toni Saikkonen and Lauri Laatikainen who have carried out the programming of the ecosystem together with author Pirkka Frosti. The key experts in real estate business Aleksi Kohonen and Ida Eveliina Korhonen have contributed in the ecosystem building together with Timo Varjo. Korhonen has also conducted the commissioning with Sonja Frosti. The linked data technology employed in the ecosystem building has been developed with funding from Tekes - the Funding Agency for Technology and Innovation, and in collaboration with major Finnish property owners.

About the Authors

Mervi Himanen, D.Sc. Eng., the research director at Digital Living Finland Oy (since 2008) has vast working experience in science (since 1985) with VTT, Aalto University, the National University of Singapore, and in consulting with Ekono consulting engineers and Stanley Ass. Engineering in Canada and in entrepreneurship at Relate partnership. Her university education covers real estate and facilities management, industrial engineering and management, textile and clothing technology together with minors in information processing science, HVAC heating, ventilation and air conditioning technology, and in international economics. She has published over 350 reports, articles and conference papers.

Pirkka Frosti, the CEO and the founder of Digital Living Finland Oy (in 2008) has earlier 15 years' entrepreneurial experience as an independent software engineering and business strategy consultant. His clients have been the big key players in Finnish industry such as aviation. He is experienced in software business in foreign markets as a CEO in a joint venture with Uptime Oy. He has an educational background in software engineering, industrial management and in entrepreneurship at Aalto University.

Sonja Frosti, M.Sc. (in Cross-Cultural Psychology, Brunel University in London) a user-experience expert in Digital Living Finland Oy (since 2013) has made the co-creation a reality with high end-user acceptance. She has a strong interest in applying well-designed tools from ICT. Ms. Frosti's work with the FP7 JADE project served these aims as did her previous position at Central Union for the Welfare of the Aged, as a project planner in the Changing Minds -research project.

Timo Varjo, the Product Manager in Real Estates Business at Digital Living Finland Oy (since 2010) has professional expertise in digital asset management in real estate and has been working with different leading real estate information and maintenance systems as an administrator i.e. for housing development company Kruunuasunnot Oy. He has worked also with shipping and in administration. He has an educational background in real estate at Aalto University.

Different Methods of Integrating End Users: COM'ON Mobile Service Design and Innovation for Future Smart Services

Satu Luojus & Tiina Wikström, Laurea University of Applied Sciences, Finland

Abstract

The ageing of the population requires new and more efficient services to maintain the older adults' ability to independent living. This paper will focus on the different methods of user integration applied in order to involve older adults in design process. The COM'ON project aims to develop a digital platform that allows multiple mobile services to support older adults' needs for coping with outdoor mobility issues.

Since the early stages of the project, users from five countries have been involved in the human-centered design process. Projective methods were used in the early phases of the project to increase understanding of the user requirements and the context of use. The creation of the design solutions was based on the insights gained in the first phases. The design work then continued in dialogue with the users. In order to get feedback on the design solutions, co-creation sessions with the users were conducted, and to continue the development of the new service concepts, interaction and graphic tests were arranged. Finally, in order to anticipate the impacts of the developed services and their suitability to the users' daily lives, the service prototypes are being tested in real life context by authentic users for a couple of months. This paper will provide examples and analysis of the methods used in the different phases of the COM'ON project.

Keywords

Mobility of the elderly, motility, mobile services, human-centered design

I Introduction

We are getting older and living longer. For example, from 2012, the European working population will start to shrink, while the over-60 population will continue to increase by about two million people a year. Naturally, such a development has great economic and social impacts and challenges in terms of all societies, families and individuals.

Therefore, all steps that can be taken to mitigate the possible negative effects and burdens created by this otherwise positive phenomenon of longevity need to be promoted on all levels of society and by all possible means.

One such step for positive engagement of the elderly is to promote their physical activity – to encourage them to be active and mobile as long as possible. This is also the objective of AAL JP that endeavors to enhance the life quality of older people and at the same time strengthen the industrial base in Europe through the use of Information and Communication Technology (ICT). For the elderly, this means ICT based innovations and solutions that can promote their overall wellness. The elderly live more and more in urban environments that allow them to be close to different services and possibilities for physical activity and social interaction and yet, many of them also suffer from loneliness and social isolation. Being physically active and mobile can help the elderly to remain also socially active, and ICT solutions that are able to both promote physical mobility and lessen social isolation are thus very welcome.

As Flamm and Kaufmann describe in their article on operationalising the concept of motility (2006), spatial mobility is a key component in the modern society, a highly valued and vital element of human existence that is closely linked with individual freedom on all levels of life and has also social implications, for example, in terms of delocalization of local services or the increase of everyday life spaces. These writers claim that "in this context, the capacity to be mobile, or the notion of motility, is a deciding factor of social integration" (Flamm and Kaufmann, 167). In an earlier publication, Kauffmann (2002) developed this concept of motility to be able "to deal with the increase in the number of travel methods in time and space occurring, with greater diversity in travel behaviour among a population and greater variety in the behaviour of a single individual" and to better understand an individual's mobility potential "and how one organises and transforms this potential into travel" (Flamm and Kaufmann, 168). As a concept, motility includes the factors related to access (the conditions under which available options can be used), skills (required in order to use these options) and cognitive appropriation (the evaluation of the available options vis-a`-vis one's projects), and one's potential may or may not be transformed into actual travel where different forms of mobility are combined (Flamm and Kaufmann, 169).

To promote the general mobility, European cities provide much useful information for regular travelers but this information is rarely optimized for the elderly users. Older people in today's society must be able to encounter diverse ICT devices and applications daily, which may appear complex and difficult from the user's point of view. Even if some of the special needs of the elderly ICT users have been recognized, these needs have often been neglected, when designing such devices for this client group.

Hence, the Confident motion (COM'ON) project (www.comon.lu) takes a holistic approach to this challenge by developing, in cooperation with the end users, a digital confident motion platform that allows multiple mobile services to support older adults' needs for coping with outdoor mobility issues. With the service platform called COMPANION helps older adults with mild to moderate problems with moving around to maintain their outdoor mobility for as long as possible. This in its turn will enhance and promote older adults' sense of self-efficacy by increasing their confidence and autonomy, sense of competence, security and safety as well as connectedness, which can impact positively both the mobility and the life quality of the elderly.

Based on all the above, we can ask: how to help the elderly (with mild or moderate problems with moving) to maintain their outdoor mobility for as long as possible with the help of ICT solutions? And how to empower them to take on journeys of their own and to maintain their social relations or inspire them to meet new people?

In order to answer these questions, it is necessary to gain a deeper understanding of older adults' needs for coping with outdoor mobility issues. Traditional designer centered design does not fulfill the demands placed on the development of interactive technological applications. Designers need to understand users' needs, wishes and dreams related to the product or service, which is being developed. Therefore, the elderly, as the best experts of their own everyday lives, need to be involved in the design process to inspire and inform the designers. Hence, the COM'ON project is based on Human-centered design (HCD) approach and methodology.

As far as the HCD approach goes, there are certain advantages and constraints when working with this framework. These issues will be discussed in this paper. This study addresses the following research questions:

- How can we involve end-users and take their point of view into consideration at every phase of the design process?
- What kind of methods serve such a purpose in a best possible way?
- How can we design a mobile service for the elderly in co-operation with partners from five European countries?

Finding an answer to these research questions requires a closer review of the HCD framework (Chapter II). In order to specify the necessary steps in the human-centered design process, there is a need to identify the critical phases of the HCD process and to investigate the methodological solutions (Chapter III). In addition, Chapter III describes the progress of COM'ON project that aims to develop COMPANION platform, as an example of an international HCD process. The most important results of this study are discussed in Chapter IV.

II Taking a Closer Look at the HCD Framework

Human-centered design (HCD) is an increasingly common model for the product and service design in the field of wellbeing technology. The approach is based on the principles that can be found in "Human-centered design for interactive systems" (ISO 9241-210) and that can be summarized in the following manner: (1) the design is based upon an explicit understanding of users, tasks and environments; (2) users are involved throughout the design and development process; (3) the design is driven and refined by user-centered evaluation; (4) the process is iterative by nature; (5) the design addresses the whole user experience and (6) the design team has multidisciplinary skills and perspectives. (ISO 9241-210).

HCD (ISO 9241-210) provides a framework for design and development process, but it does not assume any particular design process. It is complementary to existing design methodologies and provides a human-centered perspective that can be integrated into different design and development processes in a way that is appropriate for the particular context. HCD process consists of the four linked activities illustrated in the Figure 1. below: (1) understanding and specifying the context of use; (2) specifying the user requirements; (3) producing design solutions; and (4) evaluating the process. Whatever the design process and allocation of responsibilities and roles adopted, a human-centered approach should follow the principles listed above. (ISO 9241-210).

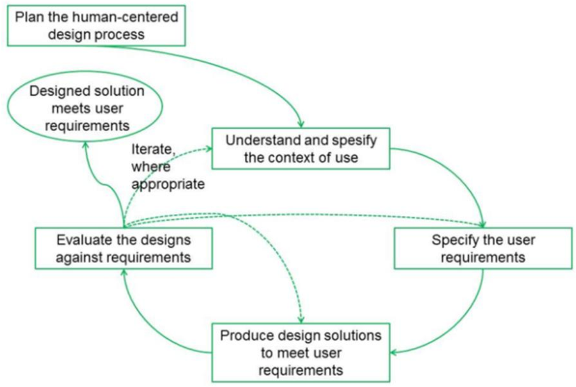

Figure 1. Human-centered design for interactive systems (ISO 9241-210, 2011).

A human-centered approach is naturally focused on the human perspective. The approach favors qualitative research methods because research data gathered by these methods provide stimuli that allow ideas and insights to be created and opportunities to share them (Mattelmäki 2006). Sleeswijk et al. (2005) divide methods into three categories according to the focus of the method: say/think, do/use and know/feel/dream. "Say/think" relates to interviews and to explicit knowledge, whereas "do/use" relates to observing the situation of usage. "Know/feel/dream" refers to physical or visual aids to allow people to visualize and describe their expectations and dreams, or tacit knowledge (Figure 2.) (Sleeswijk et al. 2005).

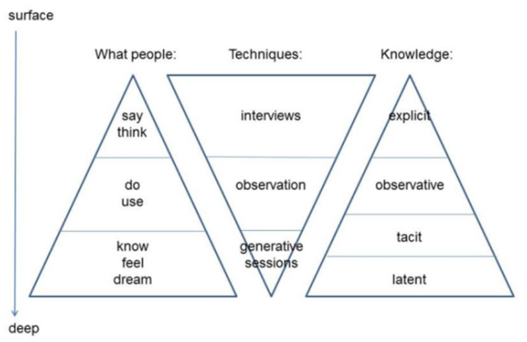

Figure 2. Division of user research methods by Sleeswijk et al. (2005).

One of the major challenges is to make tacit and latent knowledge visible. These types of studies require methods for examining phenomena that cannot be grasped by means of direct observation and understanding. Tacit knowledge turns visible through finding applicable research, cooperation and working methods. Method triangulation – using not just interviews and observations but allowing also generative sessions – improves the reliability of the study by offering richer and more versatile data to describe and understand the everyday life of users. (Luojus 2010).

III The Critical Phases of the HCD Process

The first phase of the HCD process consists of implementation and the relevant questions at this phase are, for example: How was the case implemented? What were the steps taken, and what changed during the course of the case? What factors played a role? What were benefits and challenges of the methods chosen to implement this initiative?

In order to answer to these questions, this paper focuses on different methods of human-centered design applied in the COM'ON project, running in five European countries between 2012 - 2014. The project is funded by the Ambient Assisted Living Joint Programme, financed by the European Commission and the countries that constitute the Partner States in the consortium; Denmark, Finland, Luxembourg, Belgium and Spain. The partners include Copenhagen Living Lab, Laurea University of Applied Sciences, Enthoven Associates Design Consultants, i2cat, Xtel, Actimo and Concept Factory.

As mentioned above, the project aims to develop a digital confident motion platform that allows multiple mobile services to support older adults' needs for coping with outdoor mobility issues. The phases which are in accordance with the HCD process can be found in the COM'ON project. The progress of the project is illustrated by Tables 1 – 4 below.

Understanding and specifying the context of use

The first HCD phase, **Understanding and specifying the context of use**, was focused on synthesizing insights from the participating countries in relation to older adults' outdoor mobility issues. The objective of this phase was to analyze and describe the context of use to ensure highest possible relevance of the design solutions. It also created a foundation that guides the further development process by collecting the insights from the participating countries into a shared understanding of older adults' coping with their outdoor mobility issues.

The desk research enabled the design team to create a common understanding among the project partners of the field they were approaching. The desk research also formed a base for hosting national co-design workshops using LegoREAL-Play method. This method is a modification of LEGO® Serious Play or LSP, which is based on four theoretical directions, namely 1) Constructivism (Jean Piaget), 2) Constructionism (Seymour Papert), 3) Play and 4) Imagination, and which was developed out of the problem within the Lego company – how to ask the adults to build their vision for the future of Lego company. In practice, LSP is a facilitated workshop where the participants answer different questions for example on some ongoing project, task, or strategy by building out of LEGO® bricks symbolic and metaphorical models. The atmosphere of LSP workshops is meant to be nonjudgmental, freethinking and playful to encourage the participants to find creative solutions and points of view. (Moeller & Tollestrup 2013).

In connection with the COM'ON project, Lego bricks were used in the co-design workshops as a means of supporting the process, which aimed to understand better the everyday challenges related to outdoor mobility (both practical/physical matters and mental/cognitive) and to see, what challenges the ease of getting around when growing older and what kind of concerns may arise. Also, it was important to find out, what the seniors do to cope with the difficulties and what motivates them to overcome the barriers. Important unmet needs and desires were identified, prioritized and turned into innovation opportunities and design criteria. In this way, the LegoREALPlay workshops resulted in defining scope and focus for following ethnographic based pre-studies conducted qualitatively in the five partner-countries (Fig 3).

Figure 3. LegoREALPlay.

An ethnographic study was conducted to deepen the understanding of the insights that were gained in the LegoREALplay workshops. The ethnographic study aimed at identifying focus areas within the problem of coping and lack of self-efficacy that the COMPANION services could address, as well as to outline such situations and different contexts where the COMPANION applications could be functional and feasible.

Ethnography is developed originally by anthropologists studying the cultures of aboriginal people. Nowadays the method has become common in other fields of social research, such as sociology, management and human computer interaction to study settings in real-life context. It aims to produce a detailed description of how a particular cultural group acts, based on observation of, or participation in, the group.

Such a study provides rich, holistic insights into people's views and actions, as well as the environment they inhabit, through the collection of detailed participating observations and in-depth interviews. During the interviews the users mapped their journeys by drawing mind-maps. A mind-map is a graphical representation used to visually outline information.

The user inputs were documented, processed and analyzed, using qualitative data analysis. The results of the ethnographic study and the observations and findings provided by LegoREALPlay workshops were further processed and visualized by drawing personas based on each user's everyday mobility.

The creation and use of "personas" (Fig. 4) is a common interaction design tool (e.g. Cooper 1983, Grudin & Pruitt 2002, Chang et al. 2008, Saffer 2010). By giving voice to the users – who cannot be present in the design process all the time – "personas" is a powerful design tool in practice. In COM'ON project, personas were created and visualized in order to crystallize characteristic elements of the various user groups, as revealed in ethnographic studies. Personas are based on a fictional character, but they assume the attributes of the groups they represent: from their social and demographic characteristics to their expectations, needs, desires, behavior, habits and cultural backgrounds (e.g. Cooper 1983, Grudin & Pruitt 2002, Chang et al. 2008, Saffer 2010). Personas are used for communicating data that is collected using other research methods (Grudin & Pruitt 2002). In the COM'ON project, such personas were used to describe the issues and values that are common to all the users of a certain user group identified in the empirical study. These personas and mind-maps were then used as a tool for communication amongst the design team members and between different stakeholders.

Table 1. Understanding and specifying the context of use.

The related HCD phases	HCD activities in the COM'ON project	Motivation for using the method
I Understanding and specifying the context of use	**LegoREALPlay** workshops conducted in Finland, Belgium and Spain in April 2012: - End users: the elderly with mild or moderate problems with moving - Research material (documented in notes, photos, video recording): LegoREALPlay workshop sessions with 10-12 users in each country - Method of analysis: content analysis	The main aim LegoREALPlay workshops was to gather user data in order to understand * everyday challenges related to outdoor mobility (both practical/physical matters and mental/cognitive) * what challenges the ease of getting around when growing older and what kind of concerns may arise *what the seniors do to cope with the difficulties * what motivates them to overcome the barriers
	Ethnographic study (e.g. participatory observations and semi-structured interviews) conducted in Finland, Denmark, Luxembourg, France and Spain in May 2012: - End-users: the elderly with mild or moderate problems with moving - Research material (documented in notes and photos): observation sessions (1 - 2 journeys/user) and a semi-structured interview with mapping of journeys in each country, altogether 20 - Method of analysis: content analysis	The main aim of the ethnographic study was to gather user data in order to understand * individual options of access, constraints and competences and the way they correspond to personal perceptions of opportunities, choices and actions of movement * what are the specific planning, sharing and on-journey jobs (and strategies) to be accomplished, which competences are acquired – and what kind of barriers appear in practice when following different strategies for moving around using public transportation * connections and the use of public transportation * access, competence and appropriation concerning mobility
	Personas were created by using the key elements (which affect mobility and motility) found in the theoretical framework and identified in ethnographic studies.	
	Mind map of journeys were created with the users to illustrate their everyday outdoor mobility during a typical week including particular events (for example hospital visits, birthdays and so on)	

Specifying the user requirements

The objective of the second phase, **specifying the user requirements**, was to reveal, analyse and describe end-user needs and to specify user requirements. Based on user insights gained on the previous phase, the co-design workshops were arranged. The aim of the workshops was threefold: (1) prioritise the needs we already determined; (2) understand other needs the users might have; and (3) evaluate the design solutions by the users.

The use cases are traditionally used in the interaction design for the development of the interaction flows. Functionality of the system can be illustrated by using use cases as a tool of communication in the design team and between different stakeholders. In the COM'ON project, visual use cases were created to define the interaction between a user and an interactive system by listing the steps the user has to take in order to achieve his/her goal with the system and to gather feedback on different design solutions.

As a term, co-design broadly includes all creative joint activities of the design process by designers, end-users who are not trained in design and even other stakeholders (Sanders et al. 2001). Design professionals empower, encourage, and guide users, the best experts of their own everyday lives, to bring their expertise in the design team by participating in the process as design team members. The co-design activities aim at searching for new ideas and producing design solutions.

These activities may include, for example, different tools, such as design games and issue cards.

Design games are about staging participation, so there is seldom competition over who is the winner. However, there are rules and tangible game pieces that guide the design moves (Brandt 2006). The context-specific nature of design games during the co-design sessions allows sharing the references in order to bridge different points of view – such games provide a common platform for the conversation between all the participants. Instead of the design team coming up with their own and maybe limited ideas, games can involve a broad spectrum of players, animate their participation and obtain better insights. At best, the games can help bring tacit knowledge to the surface by providing tools for idea articulation. The accessibility of design games – especially in terms of rules and languages – has to be guaranteed in order to allow the participation of each individual. (e.g. Brandt 2006, Vaajakallio 2012).

Also, the so called issue cards can be applied in co-design activities. The issue cards are a physical instrument that can promote interactive dynamics inside a team and also amongst end-users. Each card could contain an insight, a picture, a drawing or a description; anything and everything that is able to suggest new interpretations of the problem and allow different points of view. At best, the result is the identification of new criticalities and opportunities in the context of reference. The heterogeneity and simplicity of the contents are key issues to guarantee the success of this tool. (e.g. Spencer 2009).

In both of the COM'ON workshops, co-design methods were applied to deepen the designers' understanding of explicit and implicit user needs in relation to older adults' outdoor mobility issues. In order to inspire and encourage the users to express their thoughts and ideas, the designers created visual innovation cards, which illustrated various examples of potential information and functions to include in the COMPANION application. The users used the cards and use cases as tools to comment and evaluate the ideas in the co-creation workshops. The output of the workshops was translated into user specifications for the innovative service and in the first paper prototypes used then as input for the next phase. In addition, information about anticipated impacts on relationship and concern were gathered by a questionnaire from the elderly, and their companions were interviewed. The user inputs were documented and analyzed, using qualitative data analysis.

Table 2. Specifying the user requirements.

The related HCD phases	HCD activities in the COM'ON project	Motivation for using the method
II Specifying the user requirements	**Use cases** were created to define the interaction between a user and an interactive system by listing the steps the user has to take in order to achieve his/her goal with the system	
	Co-design Workshop (for example design game with cards) in Finland, Belgium and Spain, in October 2012: - Test persons: the elderly with mild or moderate problems with moving - Research materials (documented in notes, photos, recordings): workshop sessions with 6 - 7 users in each country - Method of analysis: content analysis	The objective of the co-design workshop was threefold: * to validate the service concept with our target group * to prioritize the needs already determined * to understand other needs they might have
	Co-design Workshop (included for example evaluation of the concept descriptions and design game with cards) in Finland, Belgium and Spain, in April 2013 - Test persons: the elderly with mild or moderate problems with moving and their companions (e.g. next of kin, spouse, relatives, friends, neighbors) - Research materials (documented in notes, photos, video recordings): Concept evaluation, card sorting game and group interview with the elderly. In addition semi-structured interview (personal or telephone interview) with the companions. - Method of analysis: content analysis	The objective of the co-design workshop was * to gather feedback on the core concept from the older adults' and from their companions * to gather information about the anticipated usage of the service and motivations to use the service from the older adults' point of view ? * to gather information about the need for additional services from the older adults' point of view ? * to gather information about anticipated impacts related to relationship and concern

Producing design solutions

Based on the outputs of the previous phase, the conceptual design started. The objective of producing design solutions phase was to: (1) gather information about interaction and graphic design; (2) identify possible problems related to the usage of the application; and (3) anticipate the effects of the application on users' everyday life. The first concept descriptions, such as updated use cases and paper prototypes of the user interfaces, were produced and used in usability/interaction tests.

Nielsen (1993) recommends the illustrating of design solutions with the help of prototypes because it is easier for the user to understand the concrete model and to give then feedback. Evaluation has to be made with the end users before the product is published: after the publication the correcting of the usability problems will usually be more expensive. The planning proceeds iteratively: when the usability problems are found, the new solutions will be tested again. (Nielsen 1993).

Among different prototypes, paper prototypes are a low-tech, low-cost, but highly effective, method for testing interaction design. Paper prototypes of the application were created in order to simulate the interaction between a user and an interactive system. Paper prototypes as a tool of usability testing can provide a great deal of useful feedback for the designers. (e.g. Boling et al. 1997, Snyder et al. 2003).

Usability tests have been applied to evaluate an application's prototypes of different levels of fidelity by testing it with users. Usability tests, with thinking aloud technique, have become a de facto standard usability evaluation method. In the test, these users tried to complete defined tasks with the application while observers watched, listened to and taook notes. According to the principals of think-aloud method, the test participants were asked to use the system while continuously thinking out loud (Lewis 1982, Dumas 1999). In other words, verbalizing their thoughts when they use the user interface. The main goal of a usability test is to derive a list of usability problems from moderator's observations and evaluators' analyses (e.g. Nielsen 1992, 1994) of users' verbal as well as non-verbal behavior. According to Dumas and Redish, the key principles of usability testing are: (1) The main objective of the activity is to develop the usability of the product; (2) The test participants represent the authentic end users of the product to be tested; (3) The test participants carry out real tasks with the product to be tested; (4) The researcher observes and records what the test participants do and say; and (5) The researcher analyses the data that has been collected in the usability test, identifies the usability problems and proposes improvements to them. (Dumas & Redish 1999).

Producing design solutions phase in the COM'ON project proceeded iteratively. Two different interaction tests were carried out. The objective of the interaction tests was to gather information about interaction, to identify possible usability problems related to the usage of the application and to anticipate the effects of the application. After the both tests, the usability problems that were found were analysed and new design solutions were designed and tested. The anticipated effects of the application were identified, analysed and used to inform the design decisions. The output of the phase was then translated into interaction specification and user interface specification that were used as input in the next phase.

Table 3. Producing design solutions to meet these requirements.

The related HCD phases	HCD activities in the COM'ON project	Motivation for using the method
III Producing design solutions to meet these requirements	**Paper prototypes** of the user interfaces were created in order to simulate the interaction between a user and an interactive system before the system development begins.	
	Interaction Test I (usability test) with paper prototypes in Denmark, Spain and France, in July 2013 - Test persons: the elderly with mild or moderate problems with moving - Research materials (documented in notes, photos, video recordings): 4 interaction tests in each country - Method of analysis: content analysis based on usability guidelines and heuristics (e.g. Nielsen, Shneiderman)	The objective of Interaction Test was to * gather information about interaction * identify possible problems related to the usage of the application * anticipate the effects of the application usage?
	Interaction and Graphic Test (usability test) with updated paper prototypes in Denmark, Luxemburg and Finland, in October 2013 - Test persons: the elderly with mild or moderate problems with moving - - Research materials (documented in notes, photos, video recordings): 3 - 4 interaction tests in each country - Method of analysis: content analysis (e.g. Nielsen, Shneiderman)	The objective of Interaction and Graphic Test was to * gather information about interaction and graphic design * identify possible problems related to the usage of the application

Evaluating the design

The evaluation process of the design started in February 2014. The aim of the phase is to gather information about: (1) implementation of the COMPANION application; (2) longer term usage of the application; (3) how does the application meet the users' needs; and finally (4) anticipated impacts related to older adults' mobility issues in real life context of the users.

Based on the outputs of the previous phase, the first functional prototype was produced. A functional prototype of the application is usually created in order to test the functionality and the interaction between a user and an interactive system, before the system development begins. On the other hand, by using a functional prototype in a genuine usage environment for a longer period, it's suitability for the users' needs and activities could be estimated.

During the relatively long documentation period (for the field test 1 for two weeks and for the field test 2 for two months) self-documentation will be done by eDiaries online. The output of the field tests will be taken into account when finalizing the application.

As a result of the COM'ON project, the COMPANION service platform has been created. With the COMPANION platform, it is possible to create specific planning, sharing and easily accessed and personalized on-journey services that help older adults to maintain their outdoor mobility for as long as possible. This in its turn will enhance and promote older adults' sense of self-efficacy by increasing their confidence and autonomy, sense of competence, security and safety as well as connectedness, which can impact positively both the life quality of the elderly and the economic challenges on micro and macro levels of European cities, municipalities and societies, thus providing creative examples for global use as well.

Table 4. Evaluating the designs against requirements.

The related HCD phases	HCD activities in the COM'ON project	Motivation for using the method
IV Evaluating the designs against requirements	**Functional prototype** of the application is usually created in order to test the functionality and the interaction between a user and an interactive system before the system development begins. On the other hand, by using a functional prototype in a genuine usage environment, it's suitability for the users' needs could be estimated.	Functional prototype is a tool for usability testing or for field testing to provide a great deal of useful feedback concerning interaction and functionality of the application under development. Multiple iterations of prototypes are used to progressively refine the design solution.
	Self-documentation in eDiaries and interviews during the Field Tests 1 and 2 in Finland, Luxemburg and Spain, in February – May, 2014 - Test persons: the elderly with mild or moderate problems with moving and their companions (e.g. next of kin, spouse, relatives, friends, neighbors) - Recearch materials (documented in eDiaries): about 10 - 20 elderly and about 10 – 25 companions in each country - Method of analysis: content analysis	The objective of the Field Tests are to gather information about * the implementation of the COMPANION application * the usage of the application * how does the application meet the users' needs * the anticipated impacts related to the notions of relationship and concern

IV Results and discussion

During the COM'ON project, several different research methods have been used, and a large quantity of the research data has been collected. In this paper, the focus was on different methods and tools used in user interaction and integration processes in the COM'ON project. Some of the key issues that have been raised during the development process of the COMPANION service and that can be generalized to any similar service development, based on end-user involvement, include proper integration of the end users in all phases of the product or service development.

How can we involve users and take their point of view into consideration at every phase of the design process?

The goal of the COM'ON project is to promote the mobility and active life style of the elderly by developing an application, COMPANION, that serves the end-users' needs in a best possible way. This has been accomplished by focusing on design that was based upon an explicit understanding of users, tasks and use environments and by engaging the users in the creative process throughout the different phases of design and development. In this way, a digital confident motion platform, COMPANION, that allows multiple mobile services to support older adults' needs for coping with outdoor mobility issues, was co-created with the end users. The COM'ON co-creation process including user involvement is depicted in the image (Fig. 5) below.

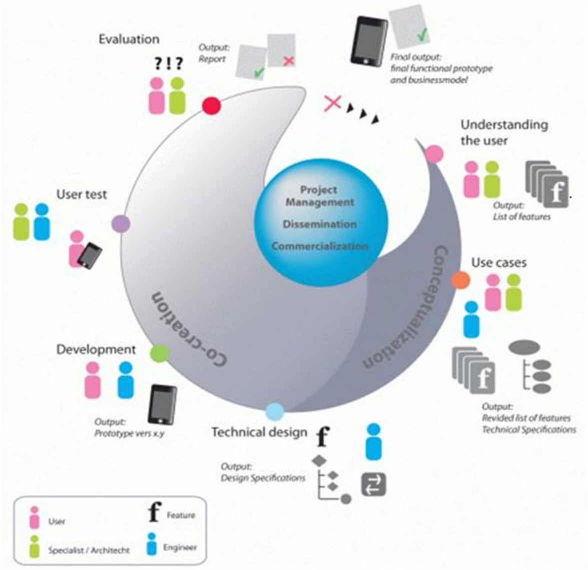

Figure 4. The COM'ON co-creation process (Hammer-Jakobsen 2011).

In the COM'ON, the end users were actively involved in all the phases of the creative process of the service design and development. The only function of the developing process the users did not participate in was technical development. This was realized by testing many different versions of the concept with end users, by using many tools and methods, and by actively implementing the valuable feedback the end users provided in different stages of the service design.

What kind of methods serve such a purpose in a best possible way?

Hanington divides the design research methods into three categories: (1) traditional methods, including market research, focus groups, surveys and interviews; (2) applied methods, which refers to using research methods from different disciplines (e.g. observation, self-documentation or heuristic evaluations) and (3) innovative methods (e.g. co-design workshops and LegoREALPlay). Innovative methods typically are identified by their participatory nature, creative engagement and outcome. (Hanington 2003).

The data acquired through traditional methods provides a good overall view of the design field, but it does not fulfil the needs of the product design process, because generalisations fail to define individual and exceptional properties (Gaverin et al. 2004; Hanington 2003). These methods were used to a relatively limited extent in the COM'ON project. However, applied methods, such as self-documentation, and interaction methods, such as thinking aloud or heuristic evaluations, were used successfully during the project. These methods formed the foundation of the user involvement in the project.

Innovative methods are seen to be particularly suitable at the beginning of the design process, because of their success in uncovering needs and desires that may be unknown even to the user. In the beginning of the COM'ON project, when understanding and specifying the context of use and specifying the user requirements phases, these methods were critical for deepening our understanding on older adults' needs for coping with outdoor mobility issues. If the design process was solely based on the insights provided by research literature or different surveys, this would have allowed only a limited understanding of the phenomenon at hand. Hence, working, for example, with Lego bricks provided a deeper and more meaningful insight into private experiences, thus allowing access to other levels of information.

How can we design a mobile service for the elderly in co-operation with partners from five European countries?

As far as the significance of the communication in the working of the international design team goes, its importance cannot be emphasized enough. There is always that great potential in multi-professional and multinational teams that can open up new visions and expand the knowledge and awareness of the other team members. The possible challenges can include such tasks as communicating unambiguously the key notions and concepts and the key tasks amongst the different professionals, in a unified language; to use methods and tools in a coherent and reliable way in different research contexts and during different phases of the project and to deliver the results and reflect upon them systematically so that all team members share all the time the latest understanding of the project status. Also, one of the key factors of a successful end user project is to understand more deeply the anticipated impacts delivered by the end users. For a short term project, this naturally creates challenges in terms of delivering reliable research results and solid conclusions.

It is also essential to find the best possible methods and tools that serve the project at hand. This means that there needs to be a very clear idea of the goal and the need for information, yet also flexibility to add additional tools and methods or to remove some, if this serves the best interest of the end user involvement.

Discussion

There are established research methods within every discipline, and the research methods can be approached from many points of view. The differences between different research methods, tools and techniques are not unambiguous either. In this paper we used Human-centered design for interactive systems (ISO 9241-210, 2011) as a framework in order to distinguish the phases of the design process, and to analyse methods and tools used in the project.

As mentioned above, in international design teams the communication is extremely important. Designers need tools to assist their communication in design team as well as with end users and stakeholders. Erickson et. al (1995) write about the role of "design artifacts" in their Communication-oriented model of design, the physical or informational entities collected or constructed during the design process, as tools that support communication among the various audiences involved in the design process. The perspective of design as communication takes on particular importance because communication is difficult. (Erickson et. al 1995). We consider and call these "design artifacts" as tools.

Based on the above, we wished to categorise the methods and tools (Table 5) applied in the COM'ON project by connecting them with the different phases of the project based on how they were used. Naturally, these methods can be applied and modified for use in other project planning phases as well. Another way of categorizing methods and tools can be found in YOUSE toolkit, recently published by YOUSE and AAL Europe (for more information, kindly see: http://www.aal-europe.eu/wp-content/uploads/2014/01/AALA_Guideline_YOUSE_online.pdf). For the COM'ON project, the communication was the key theme when planning the project and when choosing the tools for interaction.

All in all, in the future, the discussion on different ways of categorising methods, tools and techniques needs to be continued within different disciplines to provide many angles on the best practices within end user integration and planning of smart services.

Table 5. Analysis of the methods and tools.

The related HCD phases	Methods	Tools
I Understanding and specifying the context of use	Data gathering methods: - LegoREALPlay workshops - Ethnographic study (e.g. participatory observations and semi-structured interviews) Analysing method: - Content analysis	- LEGO® Serious bricks - Personas - Mind-maps of journeys
II Specifying the user requirements	Data gathering methods: - Co-design Workshops (for example design game with issue cards) Analysing method: - Content analysis	- Use cases - Issue cards
III Producing design solutions to meet these requirements	Data gathering methods: - Interaction and Graphic Tests (usability test) with paper prototypes Analysing method: - Content analysis	- Paper prototypes
IV Evaluating the designs against requirements	Data gathering methods: - Self-documentation (including eDiaries and interviews) Analysing method: - Content analysis	- Functional prototype

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Acknowledgement

This research has been supported by the Ambient Assisted Living Joint Programme, financed by the European Commission and the countries that constitute the Partner States. The authors would like to thank all the contributors and the end-users who participated in the project.

About the Authors

Satu Luojus, Laurea University of Applied Sciences, Finland

Tiina Wikström, Laurea University of Applied Sciences, Finland

Let's Move Together!

Towards a Social, Mobile City

Laura van Geel, Sietse Dols & Yuan Lu, Sub-department Business Process Design, Department of Industrial Design, Eindhoven University of Technology, the Netherlands

Abstract

This paper describes a case study that employs a step-wise approach based on design driven innovation. Different stakeholders with different knowledge, experiences and skills worked collaboratively in creating open innovation of mobility product service systems for elderly in the city of Eindhoven, the Netherlands. Four parties including (1) elderly, (2) public transportation company Connexxion / Hermes, (3) the municipality of Eindhoven and (4) the Department of Industrial Design at Eindhoven University of Technology have worked closely to create such Product Service System. The approach consisted out of four different steps which started with the initiation of a design proposal, followed by a confrontation workshop, after which the concept was co-developed with the stakeholders, which finally resulted in a field pilot. In this paper we discuss the case of IRIS. This concept aims to make public transportation more accessible for elderly. IRIS calls for volunteering actions of a community of people to help elderly to travel by bus, without having to defer from their own trip.

Keywords

Social Design, Elderly, Product Service System (PSS), Mobility, Network Collaboration

Introduction

The aging society is one of the main challenges that we are facing right now. The number of people above the age of 65 will grow from 16% to 26% of the total population between 2012 and 2060 in the Netherlands (Giesbers, 2013). Specifically in Eindhoven this demographic is expected to grow from 16% in 2013 to 19% in 2025 (Huisman, 2013).

One of the projects that works in this field is the Grey but Mobile project. The Grey but Mobile [GbM] project is about "Enhanced Care Service through Improved Mobility for Elderly People by improving care-related mobility services for the elderly independent living and social connectivity are supported. Especially the quantitative and qualitative effects of these proposed services have to contribute to the improved health of the elderly as well as to the economic efficiency of care." (CRISP, 2011) This project was funded by the Creative Industry Scientific Programme [CRISP]. CRISP is supported by the Dutch Ministry of Education, Culture and Science. The Grey but Mobile consortium exists of Eindhoven University of Technology [TU/e] together with Design Academy Eindhoven [DAE], University Twente and Roessingh Research and Development [RRD]. Besides these research partners other parties from care organizations, public transportation companies, design practitioners and local municipalities participate in the project. The design case study reported here is organised by TU/e together with the municipality of Eindhoven, Hermes / Connexxion (the public transportation company, Hermes is the daughter company of Connexxion) and the elderly community.

To deal with the problem of an aging society, an open innovation approach is desired (Keller, Gäre, Edenius, Lindblad, 2009). Different stakeholders with different knowledge, experiences and skills need to work collaboratively in the creation of open innovation.

Three parties are involved in the research of this paper; (1) elderly, (2) the public transportation company Hermes, (3) the municipality of Eindhoven and (4) the Department of Industrial Design at Eindhoven University of Technology. Each party has their own challenges with regards to changes in society and the growing number of elderly.

1. When discussing elderly in this paper the focus is on people above the age of 65. For elderly above the age of 65 it is a challenge to maintain their daily use of public transportation. Currently there are some changes made in the public transportation system. In the past a paper based ticket system was used for the payment of traveling while now a digital card system has been introduced to passengers. For elderly to use the public transportation systems in this manner is a challenge since they are not accustom to the use of this new digital system. In addition increasing physical limitations makes it more difficult for them to make use of the public transportation.

2. The public transportation sector in this case is represented by Hermes, who provides the bus service within the city of Eindhoven. Their challenge is that due to the aging society their customers might require different products and services to fulfil their needs. Specifically for Eindhoven the cancellation of the "Stadspas", a free public transportation card for elderly, elderly will be forced to use the new digital card system which makes the threshold for using the public transportation service much higher than before. This could eventually lead to insufficient service occupation and eventually cancelation of bus lines that do not have enough passengers.

3. Challenges for the municipality of Eindhoven are the high expenses of healthcare, high cost of specialized transportation, the transition of care being arranged by the municipality instead of the national government and more elderly want to live independently at home.

4. "The mission of the Industrial Design Department at Eindhoven University of Technology is to perform research on, and to provide education in: 'Creating intelligent systems, products and related services in a societal context.' " (Department of Industrial Design at Eindhoven University of Technology, 2014). The challenge for the department in this case in particular is then how to conduct design research together with different stakeholders in order to create such Product Service Systems (PSS) for the increasing ageing community in Eindhoven.

This paper discusses the research experiences related to the facilitation of collaboration in the stakeholder network, within the given context and challenges described before. The goal was to get a consortium of different stakeholders with different knowledge and expertise to work on a joint project that eventually would be evaluated in a field pilot. In the collaboration, not only the challenges of the end users need to be addressed but also those of the stakeholders.

Approach

To solve this complicated issue of an ageing society a four-step approach based on design driven innovation (Verganti, 2009) was used. Firstly master students from TU/e created the (1) initial design proposal in an one week master course which was given by the Department of Industrial Design (Lu & Baha, 2013). Then a (2) confrontation workshop was organized to confront different stakeholders with the design proposal. This showed that the challenges and conditions involved in this kind of wicked problem are not only at a functional level but also at a knowledge sharing level, which led to further (3) co-development of the proposal and to align their own expectations with those of other parties involved. After the commitment of different stakeholders the project was turned into a (4) field pilot.

1 Initial design proposal

During a one week module Activating your Innovation Radar (Lu & Baha, 2013) facilitated by the Department of Industrial Design at Eindhoven University of Technology the initial design proposal was developed.

Set-up

The module was set-up by giving workshops to students to convey the theoretical background about PSS innovation. They were challenged to develop a PSS focused on the mobility of elderly by sensing the first, second and third person perspective of the end-user and of the involved companies. One of the deliverables of this module was an self-explanatory movie of a PSS that supported elderly to live independent (Lu & Baha, 2013).

Results

The initial design proposal was the IRIS concept which is a Product Service System that aims to make public transportation more accessible for elderly. Next to the service IRIS consists of a community of people who voluntarily help elderly to travel by bus, without having to defer from their own trip. The people from this community will volunteer to help elderly entering, travelling and leaving the bus while they are travelling themselves.

The goal of IRIS is to transform mobility from merely transportation, to a social event. For elderly public transportation becomes more social, accessible and comfortable. Through IRIS a community of volunteers is built up with a sense of responsibility and intrinsic motivation to help elderly.

The initial design proposal was presented by means of a movie. This movie of the initial design proposal can be viewed on:
https://www.youtube.com/watch?v=sb12f8FXj3E.

Conclusion

The module set-up resulted in a concept movie of an initial design proposal for a PSS. This PSS related to making elderly live independent at home longer. By means of this movie the initial design proposal could be communicated to the stakeholders.

2 Confrontation workshop

In order to evaluate the initial design proposal from different stakeholder perspectives, a confrontation workshop was held on February 1th 2013, 24 partners related to the Grey but Mobile consortium participated in the workshop. The purpose of the workshop was to confront the initial idea with the stakeholders and to construct the initial business case idea together with them. Eventually these stakeholders can use the initial business case idea to convince their own organizations to participate in co-creating the future solution. Also the intention was to show the business potential to the stakeholders as well as enabling the stakeholders to adopt the concept.

Set-up

The workshop was divided into three parts; the first part consisted out of a presentation (see figure 1: Presentation of IRIS) of the IRIS concept that was developed prior to the workshop.

Figure 1: Presentation of IRIS

During the second part of the workshop the group, was divided into three smaller groups which, developed a business pitch that the stakeholder could tell to convince people within their organization. A What, Why, How canvas (based upon the theory of Simon Sinek (Sinek, 2010)) was provided which gave them support in the development of their pitch.

At the third part of the workshop the pitch was discussed by the group. Feedback on the concept was given and issues related to the intended implementation of the concept into a pilot by industry partners were discussed.

Results

During the discussion, it became apparent that two stakeholders directly related to the initial IRIS proposal, Hermes and the municipality of Eindhoven.

For Hermes the benefit would be saving money and improving the travel experience. The benefits for the young people would be to feel more proud and the elderly would feel welcome, secure, confident and appreciated. Their goal is to implement it by means of a low fidelity pilot that can be expanded. For this pilot Hermes has the following already in place; access with social media to start up a community and possibilities to increase technical solutions within Hermes. They want cities, care organizations and elderly organizations to join them to set-up a pilot team.

Expected benefits of this concept for the municipality of Eindhoven would be less cost, less traffic, more people that take the bus and more cohesion within society. Two target groups were defined helpers and people in need. For the helpers the benefits will be feeling happy to help another, a sense of belonging, a better health and more independence for the people in need of help. To start the pilot they indicated to have in place a bus route, people who need help, people who want to help and the results of earlier pilots of public transportation services. They will need the city council to agree with the plans, also they need to cooperate with a bus company and they want someone to facilitate the pilot.

Conclusion

In this workshop there was a clear adoption of the concept by two of the stakeholders; Hermes and the municipality of Eindhoven. This was facilitated by the process and materials provided in the workshop. The presentations showed the intention of the stakeholders to adopt the concept and what they already had in place for the development of a pilot. This was valuable input for co-development of the concept.

3 Co-development

The initial design proposal was further developed by means of co-development with the stakeholders TU/e, Hermes and the municipality of Eindhoven during a period of 24 weeks. Which eventually turned into a field study as part of the graduation project of a master student (second author) Industrial Design of the Eindhoven University of Technology.

The focus of this co-development was on the areas of; (1) feasibility, (2) acceptance (3) evaluation.

1. Feasibility of the concept was viewed from the stakeholders perspective. To determine the feasibility of the concept, the touch points of the PSS were explored and reviewed with the stakeholders. The review focussed on how the stakeholder could place the final PSS into the market, with their current expertise and work area.
2. Acceptance of the concept by elderly. In parallel to the exploration upon the touch points, additional user insights were gathered through interviews with potential users of the system.
3. Further development and evaluation with elderly. Based on the aforementioned points the PSS was prototyped and an initial review of the system was done.

The concept of IRIS is to make public transportation more accessible for elderly with decreased mobility by supporting interaction between the elderly and other travellers, so that they receive help when they need it. Exploration of the concept provided two main directions; spontaneous travel system and pre-planned travelling.

With the spontaneous travel system, users of IRIS can travel with the public bus transportation without pre-planning. They show their public transportation card with an IRIS sticker to the bus driver. By showing this sticker the bus driver knows when help is needed. The bus driver is provided with a screen on which he can see if volunteers are on board and can call for help. Volunteers install an application on their smartphone to detect when they are travelling by bus and to prompt, via the application, when help is needed.

The pre-planned travel system is a website that elderly can use to plan their trip. When someone plans a trip via the IRIS system, they are coupled with other travellers who frequently use that bus line. On forehand the volunteer and elderly have an appointment to travel with the same bus.

Set-up

At this point there are two concepts at the system level the spontaneous travel system and the pre-planned travel system. The next step was to review the concepts with stakeholders. This was done by looking at the pros and cons of each concept from the point of view of the stakeholders as well as looking at how the system could be implemented. Important input for this were the earlier gained user insights, which were obtained through interviews with elderly.

Results

For the spontaneous travel system to work, a big group of volunteers is needed from the start, because elderly who want help need the guarantee that they will receive help. The network of volunteers could potentially be created through an extensive marketing campaign. Additionally the equipment needed for the bus drivers has to be installed on the whole fleet of busses since the busses are not line bound. Therefore this direction of the concept would require a large investment.

The pre-planned travel system on forehand couples the volunteers and elderly. Therefore the network of people required for the system to work would be substantially smaller. Furthermore no additional equipment needs to be installed in the bus.

Even though it was clear that the spontaneous travel system could potentially serve a larger target group, because of the low fidelity touch point for elderly. For the field pilot a low-risk, low investment approach was chosen. Thus to further determine and evaluate the potential of IRIS a mobile online platform will be prototyped through which users can plan their trip.

Conclusion

The step of co-development lead to the development of two systems; the spontaneous travel system and the pre-planned travel system. By reviewing the pros and cons of each concept from the point of view of the stakeholders and by looking at implementation possibilities the choice was made to take the low-risk, low investment approach. To further develop IRIS a mobile optimized online platform was prototyped through which users could plan their trip.

4 Field pilot

The goal of the field pilot was to gain insight into the current mobility and travel experience of the participants compared to the usage of IRIS. Therefore an evaluation was performed over a longer period of time to gather qualitative and quantitative information.

Set-up

The validation of the IRIS concept was twofold consisting out of a (1) field study and a (2) reflection workshop.

1. For the field study of IRIS a three week system level evaluation based on an A-B-A test was set-up. This was needed to ensure that participants used the bus multiple times. In the first week (A) a baseline measurement was done, the second week (B) the participants used the IRIS platform to travel with the public bus transportation and in week three (A) the participants travelled without IRIS to evaluate the change of behaviour.

Materials that were provided to the participants were the IRIS platform on an Android smartphone, a diary and an activity sensor. With the diary study (Martin & Hanington, 2008) and interviews qualitative data was gathered.

The IRIS platform was prototyped as a mobile optimized website (see figure 2). Users have their own personal profile with photo. Through their profile they can plan trips and see an overview of upcoming travel plans, including a photo of the travel companion. The trip planner offers suggestions for bus stops based on data made public by the 9292Opendata initiative (2014).

The provided smartphone has the IRIS travel planner bookmarked to the home screen for quick access. Users receive standardized text (SMS) messages for reminder and confirmation of the trip. On the backend the coupling and planning of the trips is done manually. This is inserted back in to the database so that the user perceives it as an automated system.

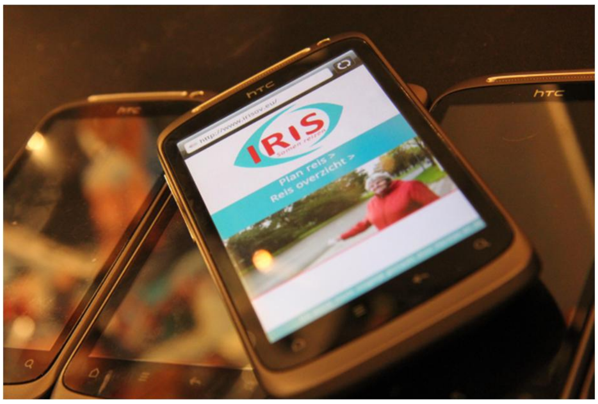

Figure 2: IRIS platform on the mobile phone

The diary (see figure 3) included the Life Space Assessment questionnaire (Stalvey, Owsley, Sloane & Ball, 1999) to determine the mobility range of the participant and a set of daily questions mainly related to their travel experience within the public transportation. The questions related to the travel experience were mainly based upon the OVKlantbarometer develop by Ministerie van Infrastructuur en Milieu and Kennisplatform Verkeer en Vervoer (2012), a yearly research conducted by the government and public transportation companies to measure the customer satisfaction. Since the test was done over a long period of time it was opted to use diaries to ensure experiences could be noted shortly after they occurred rather than having to wait until the end of the three week test. Participants were asked to update their diary whenever they made a trip outside their house.

Figure 3: Mobility diary

Next to keeping the diary, participants were asked to wear an activity sensor that was developed by RRD. This sensor measured the daily physical activity through an accelerometer which provides quantitative data to determine the participants mobility objectively. Also the IRIS web log files gave additional qualitative information.

During an introduction interview in the first week all the aspects of the user test were explained to the participants. Moreover, together the first few pages of the diary were completed. At the end of the three week period an interview was conducted for which the diary served as input.

Besides this evaluation a group reflection session was organized with four elderly participants aged 81-85 years old. The goal of the session was to determine the value of currently used transportation types in relation to their mobility compared to the IRIS concept. Several cards with various aid and transportation types were given to the participants to support the discussion. The participants placed these cards on a canvas (see figure 4) based on the Life Space Assessment model (Stalvey, Owsley, Sloane & Ball, 1999).

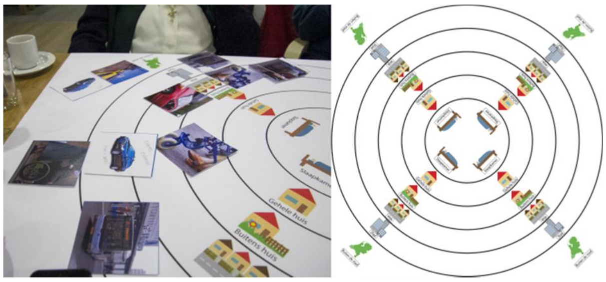

Figure 4: Reflection session with canvas

Results

IRIS has potential for users who plan their trip, as long as it is clear they maintain the flexibility to cancel a trip. While the initial target group of IRIS was elderly aged 65+ years old with decreased mobility, for this concept direction a more fragmented user base appeared more appropriate. Due to the web based touch point, users need to have affinity with technology. Furthermore it requires a higher self-awareness of their own mobility since they make a more conscious decision to ask for help.

Within the development of the field pilot it was chosen to take a low-cost, low-risk approach. While this approach allows for an organic growth of the network at a relatively low-cost, it also gives limitations. In this case it was hard to reach the potential target group, since a small group of early adopters was needed instead of a large crowd. Furthermore during the recruitment of participants it became apparent that a combination of factors affect the acceptance of the PSS. Firstly trust plays a large role for elderly and for changing their regular pattern they need a really strong apparent value. The initial threshold to differentiate from their usual behaviour underlines the need to build up a reputation to gain acceptance. Since the current system had no reputation of itself the trust of the participants was depended upon the manner they were recruited for the pilot.

Conclusion

IRIS has potential as long as elderly have the freedom to plan and cancel their trip. The value of IRIS is only apparent for people who have affinity with technology. Also it appeared that the target group was more fragmented then anticipated upon, because of the low-cost, low-risk approach.

For the concept to work you need a small group of early adopters. The struggle was noticeable in the recruitment of participants since first a relation of trust had to be build with the participants. Therefore the reputation of IRIS plays an important role in the acceptance of elderly.

Overall conclusion

Based upon the case study a number of conclusions can be drawn by looking at the approach and by looking at the design case.

In this paper we discussed a four step approach on how to design Product Service Systems based upon design driven innovation. The first step was the initial design proposal which enabled the set- up of a confrontation workshop. Also it supported in the communication of the concept to the stakeholders by means of a video.

The confrontation workshop supported the stakeholders in the adoption of the concept, which lead to the involvement of stakeholders in co-development of the concept. Also the set-up of the workshop supported the stakeholders to develop the first business idea of the concept.

In the step of co-development the initial design proposal and business idea were reviewed with the stakeholder by looking at the pro's and con's from their perspective. This helped in the development of two possible implementable concepts and making a selection for one concept for the field pilot.

The field pilot showed the limitations of the concept by taking on the low-cost low-risk approach. The low-cost, low-risk approach gave limitations with regards to the adoption of the system by the end users. For this to work you need a small group of early adopters. The struggle was noticeable in the recruitment of participants since first a relation of trust had to be built with the participants. Therefore the communication of IRIS plays an important role in the acceptance of elderly.

Lessons Learned

The lessons learned from this study are twofold; (1) continuous sharing of knowledge (2) access to elderly community.

1 Continuous sharing of knowledge

One of the lessons learned is how to maintain continuous and timely knowledge sharing among a large group of stakeholders. When working with a large amount of partners form different sectors it is important to organize workshops and update meetings. The organization of such event should be more in the long term planning of a project. How to share timely explicit and tacit knowledge among different stakeholders remains an interesting question to be explored further. Earlier research has explored the use of social media in supporting knowledge sharing in such a context, specifically focusing on asynchronous knowledge sharing in collaboration processes (Sturkenboom, Baha, Lu & Tempesta, 2013). The lessons learned that a system level solution is needed to support both synchronized and asynchronous knowledge sharing in the collaborative process. Gupta & Govindarajan (2000) distinguished four different knowledge transfer contexts in multi-stakeholder network. In the future it is necessary to take these four contexts into account when designing for continuous sharing of knowledge.

2 Access to the elderly community

Elderly are a very interesting group of consumers in market research. How to get them participating and co-creating the intended services for themselves in a large scale with intended societal impact, remains a challenge for the open innovation adventure reported here. Despite the strong participation of the elderly target group in this study via care organizations and neighbourhood initiatives when creating the initial concept, recruiting elderly for the field pilot appeared to be difficult. It appeared that the indirect connections to get in contact with elderly were not strong enough to get the elderly excited to participate in the pilot. At the moment the project is exploring the use of project ambassadors through elderly representatives in order to get more attention of elderly for such initiatives to make our society better.

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Acknowledgements

This case study would not be possible without the support of a large variety of people. While some are mentioned here by name, this does not exclude all of the others who have inspired and cooperated this case study.

Furthermore we would like to show our appreciation for Tijmen van Gurp, Mark Kwikkers and Marieke de Rooy with whom IRIS was initiated during the Activating your Innovation Radar (AYIR) module and also Ehsan Baha, co-lecturer of the AYIR module, whom helped greatly by sharing his knowledge.

Also we would like to thank Marco Cowan (Connexxion) and Fred Tilburgs (Hermes) for all their feedback and time invested, all other industrial partners from Hermes, Samenwerkingsverband Regio Eindhoven and the Municipality of Eindhoven who have share their thoughts and expertise. Also we would like to thank all the elderly who voluntarily gave their time to participate in this study.

About the Authors

Laura van Geel MSc. Is a research assistant in the sub-department Business Process Design at the Department of Industrial Design, Eindhoven University of Technology. She has a bachelor and master degree in Industrial Design from Eindhoven University of Technology. Here research is related to how to design for social wellbeing with a focus upon societal issues. l.c.h.m.v.geel@tue.nl

Sietse Dols BSc. is a master student at the Department of Industrial Design at Eindhoven University of Technology. For his master graduation project he worked on the development of IRIS. He is interested in using product-service systems to work on complex societal issues. s.a.e.dols@student.tue.nl

Dr. Yuan Lu is an Associate Professor in the sub-department Business Process Design at the Department of Industrial Design, Eindhoven University of Technology. She has a bachelor degree and a master degree in Mathematics from Xi'an Jiaotong University in China. She has also a master degree in Industrial and Systems Engineering from National University of Singapore in Singapore. She is the first joint PhD between National University of Singapore and Eindhoven University of Technology. Her research interest relates to exploring the use of field probes to create innovation opportunities with multi-stakeholders, especially for the increasing ageing societies. Y.lu@tue.nl.

Exploring the Potentials of ICT Enabled Co-creation Platform for SME's in Ikeja ICT Cluster, Lagos

Gospel Oparaocha & Calkin Suero Montero, School of Computing, University of Eastern Finland, Finland &
Raymond Adagbon, Center for Research on Activity Development and Learning, University of Helsinki, Finland

Abstract

This case study explores the possibilities and critical factors affecting how an ICT cluster located in Ikeja area of Lagos State, Nigeria could be organized as smart community of co-creators who are reliant on each other for process, product and market innovations. Using the videographic enquiry method for data gathering, the study examines how inter-firm network collaborations influences the innovation generation and commercialization process of entrepreneurial ICT firms in emerging market context; and how synergies brought by co-creation process in such ICT cluster(s) could enable the small businesses to gain competitive advantage.

Keywords

ICT innovation, Co-creation, Open-innovation models, Emerging markets, SMEs inter-firm networks

Introduction

Consumers of the digital era have gotten used to the constant influx of change, and new trends which has heightened an almost insatiable taste for latest technological developments in the ICT industry. Such consumer demands and the unprecedented technological advancements have put pressure on ICT developers and manufacturers to figure out the most efficient means of tackling the challenges and promises of innovations in the increasingly competitive global ICT market. Due to such growing complexity of innovation processes, inter-organizational alliances and different forms of open-innovation network collaborations has become eminent especially for small and medium-size enterprises – (SMEs). Furthermore, as a result of various resource constraints, SMEs in the emerging markets are feeling a tougher pinch in the race for innovation. Therefore, the ability of such firms to pull resources together to create and disseminate innovations can never be over emphasized. Even so, it has been suggested that firms located in industry clusters, the geographic proximity and inter-relativity of their business offerings presents them with a much strong possibility for exploring and leveraging inter-firm collaborative innovation practices.

The aim of this case study, is to explore the possibilities and critical factors that affect how the Ikeja ICT cluster in Lagos State, Nigeria could be organized as smart community of co-creators who are reliant on each other for process, product and market innovations that will enable these small businesses to gain competitive advantage to the local consumer market even in the face of fierce competition from multinational enterprises.

Background

Scholars have argued that due to complex innovation processes and high cost of technologies, firms team up with their peers to develop, absorb or commercialize new innovations (Bengtsson and Kock, 2000; Chiaroni, Chiesa and Frattini, 2010). Therefore, even competing firms often find it necessary to develop different forms of strategic and tactical innovation collaborations in order to create value for customers and as a possible challenge to any rival (Bengtsson, Eriksson and Wincent 2010). In the case of the Ikeja ICT cluster; the ability of the SMEs to harness the potentials of collaborative innovation systems by leveraging the advantages and synergies of co-creation could play a significant role in defining the future of such emerging market ICT clusters for better or for worst. Therefore, a smart technological platform that is fully developed with and by the different players in this local ICT cluster and bearing in mind the specific needs and capabilities of the cluster could be decisive in fostering interactions/exchanges, as well as providing 21st century digital tools for managing co-creation efforts by the interdependent firms (see: Chesbrough, 2007).

Existing studies have consistently emphasized the importance of SMEs as major vehicle for generating innovation flow which is essential for sustainable economic growth and regional competitiveness (Floyd & McManus 2005; Ayyagari, Beck & Demirguc-Kunt 2007). Some scholars have produced empirical evidence why small innovative firms outperform their non-innovative peers (Nooteboom, 1994; Freel, 2000); and yet, other scholars have argued that firms located in industry clusters are more likely to be innovative and responsive to adaptive industry trends (Eisenhardt & Tabrizi, 1995; Chesbrough & Teece, 1996; Baptista & Swann, 1998). More recent studies have pinpointed the positive and negative implications of collaborative ICT platforms and living labs in enabling smart cities, and smart regions in building multi-stakeholder innovation networks, innovation management and innovation governance ties in distributed knowledge communities (Chesbrough, Vanhaverbeke & West, 2006; Chung & Hossain, 2008; Molinari, 2011; Nam & Pardo, 2011; Shin & Kim 2012).

Despite the corpus of existing studies suggesting that the implementation of ICT-based open-innovation or co-creation platforms will yield positive results, however, there is lack of knowledge on how such co-creation platforms could be implemented in the context of an emerging market ICT cluster. Considering the peculiarity of resource constraints faced by emerging market SMEs, and the distinctness of the Ikeja ICT cluster in particular; a thorough examination of the key factors that has to be taken into consideration is of paramount importance before embarking on such mission to use ICT enabled co-creation platform to transform the cluster into a smart bed of innovations.

An Overview of the Research Context

The Ikeja ICT cluster located in Lagos State of Nigeria is characterized by its small size and the heterogeneity of over 6000 mostly organically grown firms, shops and/or service outlets which provide a variety of ICT products and services, including ICT related software and hardware, and ICT consultancy. Product and service offerings of most of these individual SMEs are similar, thus creating a sense of competition within them (Awolele, 2013). Due to the small size of the individual enterprises, it seems that their innovation capability is significantly underutilized.

It is also evident that external funding/credit facilities is of paramount importance for them to be able to bring innovation to the consumers quickly considering the prevailing state of competition with multinational enterprise that are often quick in introducing counter products or service to the market which often knocks-out the SMEs' innovation efforts – thus making it very difficult for these small firms to innovate independently. Cardoso & Ramos (2009) have opined that in such context, each firm's innovative capacity will depend on technology strategy, acquisition and exploitation – and the way ideas are dealt with across the specific community [or industry cluster in the case of the current study].

In spite of these aforementioned challenges, the ICT sector in Nigeria has been consistently described by analysts as having enormous capability for innovations for the local market and even a good potential to extend towards serving the other African markets (Awolele, 2013). Nigeria being the giant of Africa with about 169 million inhabitants and 6.5% GDP growth per year (WorldBank, 2012 eastimates) represents a huge local ICT market for these SMEs. For instance for "over a decade now since the liberalization of the telecommunication sector in 1999 (Mawoli, 2009), the rate of diffusion of computers and other related ICT equipment to the country surpass any other country in the continent. The rate of adoption of ICTs in Nigeria is enormous. The liberalization have attracted more attention and it has contributed to the rise in the volume of sales of ICTs" (Oyelaran-Oyeyinka, 2006, cited in Awolele, 2013).

Research Problem

Following the preceding overview, it is perhaps self-evident that this study on the potential of ICT-based co-creation and/or open innovation platform for SMEs in Ikeja ICT cluster would shed lights on not just the advantages and disadvantages of the implementation of a digital co-creation platform but more importantly, this study will elicit knowledge on how inter-firm networks influence the innovation generation and commercialization process of entrepreneurial ICT firms in emerging market context. By using the following research question to drive our enquiry, this study aims to widen our knowledge on the issues of trust-building, knowledge sharing, and coopetition dynamics within a small ICT cluster in emerging market context:

a) *How can the Ikeja ICT cluster be organized as smart communities of co-creators?*

The above stated research question is studied as the first step on the broader series of research dealing with the over-arching issue of ***"how inter-firm alliances and institutional networks interplay with entrepreneurship innovations in the Nigerian ICT sector".***

From Smart Urbanization to Smart Economics Developments

Various notions of smart urbanization and smart economic concept have been gaining attention from both policymakers and academia in the past few years. At the same time, there seems to be increasing confusion among academics and practitioner regarding what these terms actually entails in research and practice (Chourabi et al, 2012). Scholas and analyst often use the phrases "Smart City" and Living Lab" synonymously when referring to different new urban phenomena related to sustainability and livability of a given geographic region (Glaeser & Berry, 2006; Su, Li & Fu, 2011; Nam & Pardo, 2011; Roitman, Mamou & Mehta, 2012).

According to Molinari (2011), the term "Smart City" or "Living Lab" may refer to *"multi-stakeholder platforms, which selfinstantiate into repeated collaboration trials, adopting the user driven, open innovation approach for the development and deployment of technology"* (p.131).

The smart city concept can also be conceptualized as the next-generation use of ICT in almost every sphere of any specific geographic community/region/society (Su, Li & Fu, 2011). For instance, the IBMs view of smart cities and smart planet mainly focuses on use of information technology to achieve intelligent monitory, management and operations of different aspects of the society by embedding powerful sensors and transmitters to key infrastructures such as bridges, power grids, hospitals, tunnels, roads and rail tracks, water systems, dams, buildings, etc. The power of supercomputing, integrated network systems and appropriate policy framework are fundamental to the realization of such "smart" urbanization concept (see Li & Fu, 2011).

On the other hand, the Living Lab phenomena have been mirrored by some scholars as an emerging scholarly field that promotes novel ways of innovating and managing the innovation processes (Mulvenna, Galbraith & Martin, 2009). The primary principles of the concept are built on the notion that participatory citizenry and knowledge of the crowd – based on their experiences and common needs are the fundamental starting point for a user-driven innovation process. Thus, resulting in a more efficient and impactful innovation outcomes that better satisfies the specific needs of the stakeholders (Ståhlbröst, 2008). As the living lab concepts appeals more towards new ways of going about innovation processes and innovation management; the living lab phenomena advocates interconnectedness of the society through harnessing the knowledge, experiences and everyday need of the locals to create efficient open innovation platforms that bring more dynamic and intelligent livable society (Herselman, Marais & Pitse-Boshomane, 2010).

Based on the study of Molinari (2011), it could be claimed that some key characteristics of a living lab or smart community are: a) extended involvement of all key innovation stakeholders in the partnership efforts, b) user centered design and participatory decision-making approaches, c) governance, structuration and legitimization of the multi-stakeholder platform.

Beyond Smart Technology

Even though the adoption of technology and instrumentation may allow for intelligent data-acquisition, integration, analysis and optimization in formats which could enable better decision-making in business processes through enterprise computing (Chourabi et al., 2012), however, Nam and Pardo (2011) argue that innovation in management and policy are in fact at the core of smart urban innovation initiatives. On the contrary, it is common knowledge that information science researchers have predominantly focused attention on the technology side of smart urbanization. Thus, whether we are talking about smart regions and communities from the concept of smart infrastructural urbanization or smart economy trajectories, it is important to bear in mind that smart sustainable development and better livability entails a "contextualized interplay between technological innovation, managerial and organizational innovation, and policy innovation" (Nam & Pardo, 2011, p.185).

According to Chung & Hossain (2008), social relations such as network structure, position and network ties in a multi-stakeholder platform has significant influence on the use of ICT in distributed knowledge-intensive work (p. 545). So, in other words, social relations, managerial strategy and policy frameworks are as important as the technological aspect in smart innovation and/or smart urbanization processes.

In addition to being a novel innovation approach, different living lab methods have also found relevance and usage within the scientific academic community as a user/community-centered approach for social experimentation and for investigating emergent societal phenomena such as how computer-mediated communications would be used in the future by a specific social group like children or the elderly. The same concepts are also being applied in a variety of multi-stakeholder researches – for instance, the living lab approach has crucial application in reverse-engineering research collaboration and co-creation between higher education institutes, small scale enterprises and a rural community in order to explore, re-engineer and co-create products and services that better serves that needs of the bottom-of-the-pyramid (BoP) market (cf: Mulvenna, Galbraith & Martin, 2009; Ståhlbröst & Bergall-Kåreborn, 2008/2009).

The living lab approach has strong presence in ICT innovation and relates ICT research where it has been coined as special cases of Test and Experimentation Platforms (TEPs). In this domain, the key characteristics of living labs are similar to the definitions provided earlier at the beginning of section 4 of this paper (See: Su, Li & Fu, 2011; Molinari, 2011; Nam & Pardo, 2011; Roitman, Mamou & Mehta, 2012). Figure 1 provides an overview of this concept

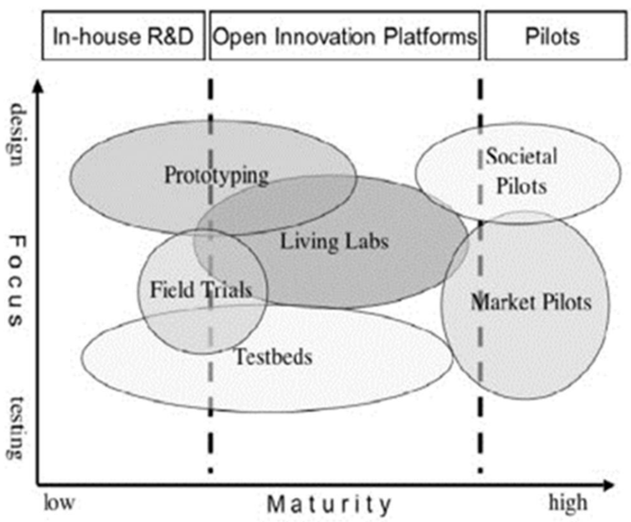

Figure 1. TEPs as a living lab approach to open-innovation accoding to Ballon et al. (2007)

Co-creation in Smart Clusters and Industrial Districts

One of the key areas in which the living lab concept has insightful application in business and enterprise domain is within the industrial clusters and business district's innovation area. Witin this focus, living labs have bee conceptualized as enabler of open-innovation and co-creation platform that enhances collaboration in enterprise and professional communities (Merz, De Louw & Ullrich, 2007; Budweg, Chaffers, Ruland, Kristensen & Prinz, 2011; Doerflinger & Dearden, 2013). It enhances skills in innovation alliances (Herselman, Marais & Pitse-Boshomane, 2010).

According to Tödtling (2001), clusters can be simply defined as "network of interdependent firms, knowledge producing and bridging institutions, and customers" that are connected in a values chain (p.59). Relationships within industrial clusters/business districts often go beyond market interaction phase. Therefore, the nature of interdependence and inter-firm network alliances reverberates key dynamics, policy and regulatory framework that influence both the out-put of individual enterprises and the general success of the cluster.

In view of the interplay of cluster relationship dynamics with business outcome [especially for small and medium size enterprises] as highlighted above, the living lab approach not only provide new tools for managing production and operations between linked organizations, furthermore, it could serve as novel model of open-innovation and co-creation system that allows a given industry cluster to be organized as a smart community of interdependent organizations which relies on alliances and networks to achieve strategic advantage in innovation creation and dissemination even in the face of fierce competition with multinational players (see Scott, Quist & Bakker, 2009). Such cluster strategy gives a region a distinctive profiling that can be used as a formidable completion instrument to ward-off unwanted in flock of foreign players in a specific sector – by collectively developing the competencies and capabilities of the local industry (Tödtling, 2001). On the other hand, it is also used as instrument for attracting investments and attention to the specific region/business community.

A significant impact of of such smart cluster strategy as discussed in the foregoing discussion could be foreseen in the ICT sector – especially within emerging markets. User-centered approach has become paramount in different forms of ICT innovations, and at the same time the pace of developing and commercializing innovations has spiraled to records high rates (Schuurman, Moor, Marez & Evens, 2009). Under such revolutions and changing competitive landscape as we are witnessing in the todays ICT sector, it is save to argue that the small players and SMEs in the emerging markets are key vulnerable groups when it come to the ability to bring innovation to market timely. Most of the challenges they face are attributed to lack of capacity and the prevailing institutional environment within which emerging market ICT firms operate. The Ikeja ICT cluster serves as a concrete example of such situations (Awolele, 2013; Chiemeke & Longe, 2007).

Based on these aforementioned arguments, we content that inter-firm alliance and co-creation approach built on the living lab model (Schuurman et al., 2010) could potentially be the most befitting framework for these enterprises to effectively confront the challenges and promises of current day turbulent innovation frontiers. Using the IKeja ICT cluster as a case-example, this study tries to elucidate how emerging market ICT industrial cluster can be organized as smart communities of interdependent firms – utilizing ICT-enabled co-creation platforms for harnessing the synergies that could lead to more successfully and sustainable ways of innovating.

The following chapter provides an overview of the method and research design that has guided this study addressing on the potentials of co-creation platforms and how it could be implemented in the context of an emerging market ICT cluster. Considering the distinctness of the Ikeja ICT cluster in particular; this phase of the study focused only on the examination of the feasibility of this type of open-innovation strategy and some key factors that has to be taken into consideration before embarking on such mission to use ICT to transform the Ikeja cluster into a smart bed of innovations.

Methodology overview

This first phase of the study deployed a qualitative research methodology using online video interview technique to capture thoughts and stories of entrepreneurial struggles by four case-firms operating in the Ikeja ICT cluster. Through semi-structured interviews, each case representative was asked to describe their *'hopes as well as concerns regarding how a potential co-creation platform might influence the smartness of the cluster in terms of innovation creation and commercialization.'*

According to Morgan & Smircich (1980), the appropriateness of qualitative research approach is contingent to the "nature of the social phenomena to be explored" (p. 491). In other words, methodological instruments appropriate for tackling a preconceived research problem and the nature of knowledge to be produced by investigating the phenomena thus justifies the research approach (Morgan & Smircich, 1980; Gummesson, 2000, 2006).

Video interview method was chosen as the means for gathering primary data because this technique is one of the most efficient methods for the case study research according to Yin (2003), and with video interviews it is possible to capture vital non-verbal communication elements which enriches the information collected from the interviewees (Saunders et al., 2007). Another key reason/benefit for choosing the online video interview method for data gathering is that the empirical material were collected over the holiday season (i.e. between 20th December 2013 – 10th January 2014). Thus, this approach eliminated cost, scheduling and time constraints; while yielding almost the same benefits as face-to-face interview.

Since this phase of the qualitative enquiry is about future expectations and projections often based on reflected experiences of past interactions and events within a somewhat closely linked enterprise community, the following logic of semi-structure qualitative enquiry formed the operational logic for the data gathering process in order to get as deep and rich information from interviewees as possible:

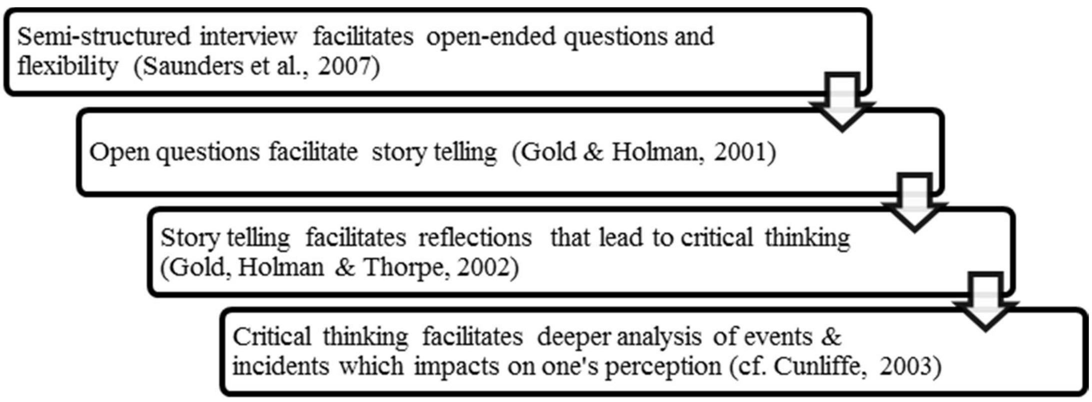

Figure 2. Reflexive research logic

General Description of Cases

Quick overview of the four case-firms that were included in this study is presented in the figure three below. Thus, the rest of the analysis and discussions in this paper is based on the accounts of these four enterprises operating in the Ikeja ICT cluster. We have coded the case firm's s alpha, beta, gamma, and delta just for the sake of protecting the identities of the firms/interviewees. The order of presentation has absolutely no relevance to the firms' characteristics; however, it only follows the interview sequence.

Table 1. General overview of case companies

Firm code	Year of establishment	Head count	No. of outlets	Product offerings	Annual sales 'aprox' [2012]	Position of inteviewee
Alpha	2001	11	1	Hardware & software	≥ $220, 000	Founder
Beta	2005	18	4	Software & consultancy	$175,000 – 190,000	General Manager
[1]Gamma	1999	47	13	Hardware, software & consultancy	$405,000	Branch supervisor
[2]Delta	1987	9	2	Hardware retail only	≤ $35,000	Inherited owner

1 Gamma has two offices within the Ikeja ICT cluster, three other operational locations in Lagos, and shops located in eight other states in Nigeria

2 Delta is a family business that stated selling onlyl typewriters in the 80s.

From the table above, it is evident that the case-firms are small enterprises with very limited resources. These are also mostly 'young' firms [i.e. with the exception of Delta]. It is save to assert that they all face similar challenges – howbeit on different scales when it comes to the need for more sustainable ways of innovating and managing innovation process. None of them has the capacity to compete with the multinational enterprises that are present in the local market.

None of these firms manufactures hardware; however, Alpha and Gamma assemble and distribute hardware, while Delta only focused on the retail of ready-packages hardware such as personal computers and mobile phones. Based on the current status, it could be argued that there is no need for innovation in the area of hardware manufacturing. On the other hand three out of the four firms offer both software distribution and minor software development. Beta and Gamma are into software consultancy.

Generally, these firms have the most need for innovation in the area of software product and service development. They also face tougher competition in the software and IT consultancy field where there are many international players with advance experience and more resources.

Findings

In other to answer our research questions, we asked the interviewees just the set of open-ended questions. First each of them was asked to describe what could be there expectations if they were to join forces with other firms within the cluster to develop and commercialize innovation. Secondly, they were asked to tell about potential concerns that relates to such joint collaboration effort. The excepts in the table below are some of the key words/phrases which streamlines the main points the interviewees used to describe both expectations and worries concerning potential interfirm collaboration[s].

Table 2. Summary of expectations and concerns

Firm code	Key hopes & expectations	Major concerns
Alpha	*'well, we already cooperate in different ways, for example if I don't have a product the customer is looking for, my boys [employees] usually gather the products from our friends across the street. So I retain the customer'* *It all depnds what type of joint effort …but I could see us doing many things together but it will bedifficult…we fit share tools like, like software development tools. And maybe also learn what we don't know but I'm afraid we don't have much to teach each other…'*	*' don't steal my customers, and don't screw things up when we share tools. Well, being able to manage the relationships is the key'*
Beta	*'you know, when we work together, we get more attention from big companies. I expect that we would have more skills combined to execute big projects also…Shared experiences is very important in projects…'*	*'In consulting, quality and accountability is important among other things…' inabilty to execute things as needed, damaging reputation, different interests, lack of skilled leadership and governance etc…'*
Gamma	*'…of course, I hope for better quality, more credibility, fresh thinking and speedy solutions, shared risks…, that is better success right?'* *'I expect mtual respect and investment, at leat shared vision, commitment… yes, its about common interest, so I don't expect us to work together if we don't have common goals*	*'the risks are many but I worry about trust the most …because then maybe we can manage the rest of the problems'*
Delta	*'…em, I think it wont happen, - we [referring to the individual firms]are.so different that we don't really ahe any possibility to combine our biness in that way'* *'oh wait… but you thing mayber these people can buy in large quentity with us? In that case the problem is small but there is also not much gain either …so its not happening*	*'I really don't know, but I still think it will not work.'*

Exisiting literature suggests that smart urbanization and development of smart business communities are necessary for a more sustainable innovations and livable society. On the enterprise side, smart community and/or living lab concepts can be seen as key strategy to mitigate some of the problems of the current innovation landscape (Molinari, 2011; Nam & Pardo, 2011; Shin & Kim 2012).

The concept of living labs as an open-innovation platform has been put forwards by researcher and analysts as one solution for effective handling of the challenges and promises of risky innovation processes (Chesbrough, Vanhaverbeke & West, 2006; Chung & Hossain, 2008).

The extract from the interview transcript presented on table 2, indicate a reasonable level of optimism could be found among the SMEs operating in the Ikeja ICT cluster. Basically, three out the four case-firms identified several potential benefits which they could gain by working collaboratively. At the same time, there seems to be a high level of risks that the interviewees associated with such collaboration and the most common concern is related to issue of trust.

Discussion

Evident from the preceding section is the fact that the collected empirical evidence seems to suggest that the majority of the firms operating in the Ikeja ICT cluster will be willing to consider an open-innovation or co-creation approach as a better way of improving their capabilities in different areas.

Smart clustering and creating value through co-creation approach

Interestingly, many key words which were used to describe their expectations are significant drivers for innovation in a co-creation effort. For instance, words and phrases such as[among others]: *"sharing tool, learning from each other, combine skills, shared experiences, shared vision, mutual respect and investment"* are all major characteristic advocated by proponents of co-creation approach (see: Chesbrough, Vanhaverbeke & West, 2006).

It is important to note that major elements highlighted by these firms as some of their expectations touches on certain key results which analysts and living lab researchers attribute to the dynamics of co-creation. For example, one of the firms described that inter-firm collaboration could bring:

> *"better quality, more credibility, fresh thinking and speedy solutions, shared risks…, that is better success…"* – Gamma

Such expected attributes seem consistent with the key benefits of better innovations enabled by the living lab approach. Ståhlbröst (2013) have shown that open-collaboration platforms has significant role in helping micro-enterprise learn the innovation process, get feedback and understand better not just their products but also the value of involving others in the innovation journey.

Some key considerations

On the side of the concerns, the most cited issues has to do with trusting the other party. There could be several different reasons and explanations why it seemed that trust could be a major issue if any collaborative innovation project is to take place between these firms. One possible explanation could be the fact that these firms might not have worked together in the past on such scales that will imply significant risks such as firm reputation being on the line. Also, since they mostly have similar products and service offerings, joining forces together will mostly ensue coopetition dynamics rather than collaboration – coopetition is simply defined as the simultaneous collaboration and competition (Bengtsson and Kock, 2000; Chiaroni, Chiesa and Frattini, 2010).

Surprisingly and contrary to conventional expectations, the issue of competition among them did not surface as a major concern that the firms would like to be considered before embarking on a co-creation initiative. Also, one would have expected that the ability of these firms to attract investment/financial support and/or credit guarantees would be highlighted as a major expected benefit that pulling the resources together will accord them. However, the firms did not stress this point, thus perhaps in another study it will be interesting to examine the reasons/reasoning behind such lack of enthusiasm regarding attracting external funding.

Towards a smart ICT cluster framework

Based on this selected overview, we can understand that paramount to elucidating how the Ikeja ICT cluster can be organized as a smart cluster, a comprehensive framework that underlines the core components that will drive and sustain both the collaboration relationship and its innovation process is needed. Thus, in order to fulfill this key requirement, we suggest the following framework presented in table three. It is based on the information contained in both the expectation and concerns of the representative case-firms in combination with the framework proposed by Nam & Pardo (2011).

Table 3. Framework of Smart innovation (Adapted from Nam & Padro 2011)

Dimension	Innovation How can we improve our products and services?	Risk What are risks from co-creation?	Part to success How can we deal with risks in open-innovation approach?
Technology (serves as tool for relationships and innovation process)	Leveraging transformational potential of ICT	-Lack of trust -Incompatibility -Reputation at stake -Quality problem -Accountability	-Governance and policy -Integration of systems and infrastructure -Trust building through mutual respect
Organization (to manage innovation)	Implementing interoperable platforms	Conflict of interest & goal misalignment	Inter-firm governance and leadership system

Preliminary conclusions

It is perhaps too early to draw any definite conclusions based on this phase of the study, however, as the data and this brief discussion has shown, it could be said that inter-firm networks relationships for innovation creation and dissemination using a digital co-creation platform will have certain key benefits for emerging market clusters. This phase of the study did not provide direct evidence in support of inter-firm collaborations influencing competition dynamics – at least from the interviewees' account of expectations. However, it is safe to argue that most of the impact that the firms are hoping for will have various indirect and even direct influence on their ability to compete to certain degree with the foreign-born players present in the local market.

In any case, the results have provided evidence that might be useful for the development of a typology of inter-firm networks dynamics within the ICT sector in Nigeria. Nonetheless, further larger study is needed to be able to understand the other needs of the stakeholders in order to be able to produce a platform design suggestion that when successfully implemented in the Ikeja ICT context could potentially transform this cluster into a smart innovation bed.

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About the Authors

Gospel Oparaocha, School of Computing, University of Eastern Finland, Joensuu, Finland

Calkin Suero Montero, School of Computing, University of Eastern Finland, Joensuu, Finland

Raymond Adagbon, Center for Research on Activity Development and Learning, University of Helsinki, Finland

Public-Private Partnership – a Contribution Paper

Henrique Diz, University of Aveiro, Portugal

Abstract

Lead by ideological assumptions or plagued by high public deficits and insurmountable public debts, many governments opted for public-private partnerships (PPP) for the satisfaction of basic necessities of their populations or their economies, keeping investment expenses out of their budgets and postponing their financial commitments. The results were varied and even contradictory. While some countries were successful by adopting PPPs in various sectors, from health to education, from roads to harbours, some others failed, with the result that future generations will have to carry the burden of arguable decisions. In this paper, an attempt is made to establish the differences between successful and unsuccessful public-private partnerships, and the relationships between public scrutiny by the civil societies and the outcome of these actions.

Keywords

Public-private partnerships, Public policies, Public investment, Sate budgets

Introduction

Public-private partnerships (PPP) are an increasing aspect of delivery of public policies and services across the world. From developed countries, as the United States, Britain or Australia, to countries which are struggling to provide their citizens the basic infrastructures and services, as Colombia, PPPs are seen as a way to transfer responsibilities and risks from the state to the private sector, in an attitude that could be seen either as the recognition that public administration is incapable of delivering, or that private entities are more effective as providers. According to Yescombe (2011), in the last decade, private sector financing through PPPs has become increasingly popular around the world in sectors like transportations, social infrastructures, public utilities and others. Already in 2005, Geddes (2005) recognised that public-private partnerships were a well-established vehicle for delivering large capital projects or managing services. However, after almost a decade, the debate about PPPs is still going on, and will undoubtedly proceed for many more years, since most of them are yet to be concluded due to the fact that they correspond to contracts as yet unfinished, and are, therefore, difficult to evaluate in their complete results.

Concepts

The definitions of Public-Private Partnerships found in the literature are rather loose and complex. It could, however, be said that PPPs are "arrangements that allows the private sector to operate a public service or infrastructure for a long period of time" (Brenninkmeijer, 2010). In any case, they will include long-term contracts, private funding, and provision of public services or infrastructures by the private sector, which should take the majority of the risk.

There are several types of possible contracts, but they could be summarized as follows: Design and Build; Design, Build, Operate and Maintain; Design, Build, Lease, Operate and Maintain; Design, Build, Own, Operate and Maintain; Design, Build, Own, Maintain and Transfer. The degree of private sector involvement and private sector risk increases from the first to the last.

The rationale for PPPs

One could argue that, ultimately, the rationale for PPPs should be based on their value for money. Link (2006) even contends that the cooperative relationships among industry, government and/or universities increase the efficiency of the research and development and, as such, contribute to the innovation system. Although it is difficult to see the direct connection between what, in fact, is a complex financial operation, and creativity, it could be envisaged that the need to be more efficient would result in any type of innovation. But there is no such evidence in the reported cases. One could see two main types of reasons for the development of public-private partnerships: political and financial.

In the late 1970s and the beginning of the 1980s, many citizens in the developed world, mainly in the United States and the United Kingdom, felt increasingly disenchanted with the services provided by the public sector, seen as inefficient and bureaucratic. The sentiment grew that the private sector could deliver more quality at a lower cost. The surge of Reaganomics in the beginning of the 1980s and the political doctrine of individual responsibility developed by Margaret Thatcher and her governments increased the force of the movement towards privatization of public services and provision of infrastructures. Many argued that there were no public responsibilities that the private sector couldn't do better and at a lower cost, as could be concluded from Machan (1995). But it would be a mistake to think that public-private partnerships started only in the final decades of the twentieth century. Already in the 1800s, many railways were built under concession that guaranteed private investors a minimum rate of return and Spain and France retook the trend in the 1960s (Funke et al., 2013a).

But, if PPPs can appeal to governments because they see a possibility of providing public services in a way that may be more efficient then traditional public funding, the global financial crisis, that started around 2008 and has since spread around the world, forced the states to look at public debt and public expenditure from a different perspective. Creditors started to doubt the capability of economically fragile countries to honour their debts and decreased the money supply. Governments saw in the public-private partnerships the opportunity to continue their investments in infrastructures and services, without any immediate increase in their spending. But one should realize that, in government funded PPPs, expenses are only deferred, and not extinct.

In both cases, the rationale of the public-private partnerships should only be their value-for-money.

The advantages and disadvantages of PPPs

When discussing the advantages and disadvantages of PPPs, it should be noted that, in spite of the large amount of publications in favour of the partnerships, "scientific empirical evidence is generally mixed and balanced" (Urio, 2010). In fact, the IMF (2004) states that "most of the case for PPPs rests on the relative efficiency of the private sector…but the theory is ambiguous and the empirical evidence is mixed".

The potential benefits, cited in various articles and books, of public-private partnerships are: an increased value for money, the optimisation of design and operations, shorter times of delivery, transfer of financial and operational risk from the public sector to private companies, larger growth of the private sector due to enhanced activity. Some authors also indicate due diligence and monitoring by debt financiers. Other advantages could be the possibility of increasing the investment in infrastructures, since the related expenses would not be included in public budgets and would not add to the public debt, and a "whole life cycle"

approach that would intensify budget certainty. Finally, the increased flexibility brought about by the PPPs in infrastructure investment and service provision could give governments political advantages.
The potential disadvantages that are frequently cited are: higher costs, resulting in higher consumer prices, higher probability of conducing to monopolies in some sectors, reducing competitiveness, long and complicated tender processes, incapability of the public administrations to deal with the complexity of the processes due to lack of competences, long and rigid contracts that may reduce adaptability to new circumstances and resulting, therefore, in more expensive or less adapted services provision. Failed PPPs due to smaller income than predicted have also to be taken into account. Reduced accountability, that is transferred from governments to private companies, and, thus, less transparency is also pointed as a disadvantage of public-private partnerships. This may lead to the question whether a commercially-driven public service will satisfy all the customers in the same way, or whether there will be a tendency to concentrate on more financially interesting "customers".

It should be noticed that a large number of the possible advantages is based on the assumption that private companies are more efficient in running projects, and managing infrastructures and services than the public sector, a presumption that has yet to be proved, and depends largely on the quality of public administration and the extent of public accountability. But it must also be said that, this being the case, the probability of success of any PPP, as far as citizens are concerned, is also reduced, since the eventual lack of competences in the public sector will result in bad planning and inadequate terms for the tenders, leading to the choice of partners to be involved. So, it could be said that public-private partnerships, by their complexity, risks associated and outcomes, "demand a new level of skills from those establishing and building" them (Geddes (2005).

In any case, one could say that political will and stability are always necessary to ensure the progression of PPPs, while corruption may be inhibit their success.

The current situation

There is a movement towards the use of public-private partnerships for projects of public interest. Between 1985 and 2011, Europe approved projects of PPPs of a total value of 353.3 Billion €, Asia and Australia 187.2, Mexico, Latin America and the Caribbean 88.5, the United States 68.4, Canada 45.2, and Africa and the Middle East 31.5 (Istrate, 2011).

There is a considerable debate in the United States on the reason why the country is struggling behind other nations in the implementation of an investment instrument that is seen as more in accordance with traditional American economic values of private initiative.

In the meantime, practically all the European Countries established PPP units at national or subnational levels. The same happened in other locations, as Australia, India, Japan, reinforcing the trend.

In recent years, PPPs have evolved from basically the transport sector, to embrace activities such as public buildings, schools, hospitals, water supply, waste management. In spite of this development, in the period 2005-2009, transport still represented 41 % of the total number of projects and 76% of their value (Colverson and Perera, 2012).

In Europe, between 1990 and 2009, and despite the fact that data availability on actual PPP investment is poor and incomplete, it can be established that the number of started projects went from 2 per anum in 1990 to 118 in 2009, with a peak of 144 in 2006, in a total of 1340. The value of the investments grew from 1 386.6 M€ to 15 740.4 per anum, in a total of 253 744.9 M€ (Kappeler and Nemoz, 2010). The major players in PPPs activities are the United Kingdom, Spain, France, Germany and Portugal. However, these investments are only macro economically relevant in Greece, Portugal and Spain. The main sectors of intervention of private-public partnerships are health, education and transport.

Finally, both the United Nations and the World Bank are using PPPs to reach their goals in many countries and in various situations, like reducing poverty and promoting development.

Evaluation and discussion of PPPs

There are a number of questions that arise from trying to evaluate public-private partnerships. The most relevant is the fact that the majority of the projects aren't yet finished, since they are long term, with a time span of around thirty years. It is, therefore, not possible to perform a complete cost-benefit analysis. On the other hand, the reason for using PPPs is not the same everywhere. In some countries it is mainly ideological, and the camp is divided through lines that are not related to economic efficiency as such, but different thoughts on how to achieve it. A publication by Education International (2009), for example, argues that the promotion of PPPs based on tight state expenditures, rhetoric of choice and competition, and that governments are not up to the job, is inherently ideological. But Utz (2009) suggests that there are many benefits in taking this approach. Meanwhile, Rosenau (1999) states that public-private partnerships do not exhibit superior performance in the criteria of equity, access and democracy.

In some other countries, the reason for using PPPs is mainly fiscal, and related to the need to keep public budgets and debts under control in the present moment, to satisfy external organisations and lenders.

Some governments choose public-private partnerships because they say there are no alternatives, derived from state borrowing constraints and their will not to increase taxes. So, if a new infrastructure or service were needed, there would be no other solution than ask for the participation of the private sector. Funke et al. (2013a) warn about the illusion of the solution because, "in the absence of efficiency gains…PPPs and publicly financed projects have a similar long-run effect on public finances". In fact, the state must still pay the full cost of the project. The payments are just deferred, not reduced. If it is a user-paying activity, it will loose the revenues that would arise from it. So, even if the present cash flow does not increase, the investment is not more affordable. There is another peril in the PPPs and the cash flow delays: governments may be tempted to be less rigorous in their fiscal policy and increase the number of projects (Tribunal de Contas, 2008a), expanding even more the future financial commitments and obligations. This is, in fact, a transition of debts to the future generations that may not even have benefited from the investment. To reduce this peril, some governments decided to have a ceiling on commitments with PPPs (Funke et al., 2013b). For example, in Brazil, the maximum value if current spending on these projects is 3% of all current revenue at all levels of government. In El Salvador, the present value of commitments cannot exceed 5% of GDP. In Hungary, in a given year, the value of new commitments cannot be in excess of 3% of total state budget revenue.

The length of the contracts of public-private partnerships, typically above twenty years, is another difficulty to be dealt with. In general, the projects are co-funded by financial institutions that require due diligence and monitoring of their development. Any attempt to change the initial conditions is met with scepticism and mistrust from the lenders, which are not willing to alter payment terms or to accept a decrease in their profits on the operation. This means that the conditions established for the project have to consider, from the beginning, alternatives to societal or economic changes that will affect profitability. Niels Bohr said once that prediction is very difficult, especially if it is about the future. And if the future is twenty or thirty years ago, it is even more difficult. The degree of the possible accuracy depends on the competences of the people involved. And in many countries, especially in less developed ones, those are very difficult to find among civil servants. In an analysis of the transport sector PPPs, the Portuguese Court of Accounts found that the lack of properly trained personnel in state institutions heavily limits their actions in the management of the contracts (Tribunal de Contas, 2008b). Also, that leads to ignorance about the real implications of the business, a fact that is "extremely severe in terms of good management of public money". In these conditions, governments use outside consultants. Once contracts are signed, they are no longer available, increasing the difficulty of changing contracts that, in the majority of the cases, have a very low degree of flexibility. This is the factor that has to be considered and included.

Perhaps the best way to start is to admit that rationale behind any form of investment should be its value for money (VFM) (Funke et al., 2013c). Basically, how much does the provision of a public service or the building of an infrastructure cost when PPPs are used, as opposed to traditional ways of procurement. If the model of public-private partnerships is to survive, it "must continue to deliver better value for money for government than any alternative delivery model" (Utz, 2009). But the question arises: is it proved that PPPs offer better VFM? The same author argues that this type of projects has lower costs and smaller delays than traditional methods. In the period ranging from 2000 to 2008, in 67 projects in Australia, over-runs were only 4.3%, compared to 18% in traditionally managed projects, and delays were 1.4%, as opposed to 25.9%. But the Portuguese Court of Accounts found huge discrepancies between projected and real costs in PPPs in the health sector (Tribunal de Contas, 2013a). And Funke et al. (2013d) argues that in both cases forecasts often seem to be afflicted by optimism and opportunism, without little robust evidence on the subject. Linder and Rosenau (2000) admit that, in the past, private organizations were seen as less committed, leaving a political question to be dealt with.

The total cost is, therefore, under scrutiny. It is common understanding that costs of projects are lower when they are run by the private sector. But some authors contest this conclusion, based on a few facts. Hall (2008) gives some examples of PPPs that incurred extra-costs to the citizens. In a city in Denmark the local taxes had to be increased by 3.2% to account for the differences in projected financial results and the reality. In Frankfurt, Germany, audits said that a school PPP project cost significantly more than if it were undertaken under traditional methods. Also, capital costs are generally lower for governments than for private companies of the same country. Second, procurement expenses increase and may well represent 10% of the total cost, while monitoring by the competent authorities may exceed 25% of the contract (Hall, 2008). The Portuguese Court of Accounts, while analysing the situation of the PPPs in the health sector, stated that there is no evidence that could confirm the assumption that costs are lower in the PPP model than in the traditional one (Tribunal de Contas, 2013b).

Risk transfer from the state to private organizations depends on the contracts that led to the PPP project. If minimum rents are assured, based on the use of infrastructures an services, as it frequently happens when building and servicing motorways, or when building and managing hospitals, then the risk is ultimately taken by the public institutions. In these cases, there is no transfer. But other contracts do not envisage a fixed minimum compensation and the risk is fully taken by the private firms. However, with the advent of the financial crisis of 2008, many states, including France, the United Kingdom, Italy, Belgium, Germany, Portugal; Turkey, Spain and Greece, issued guarantees to companies involved in PPP projects, reverting the risk from the private to the public sector (EPEC, 2011).

Where public-private partnerships take advantage is in "the whole life cycle approach", since governments do not have to intervene in the various stages of the project and so have less bureaucracy involved; in the private sector growth and stability, derived from involvement of companies in large scale projects that are run for long periods of time; and on the political advantage that governments take from launching large investments and providing services to their citizens that otherwise could not offer. But the risks are there, as previously stated, of launching initiatives that are not needed at the time, and increased future commitments that may affect public accounts.

And finally, the transfer of responsibilities to the private sector may decrease the transparency of the whole process of building infrastructures and providing services, since companies are less accountable to the citizens than governments. And the dimension of the PPPs may lead to diminishing competitiveness through the creation of monopolies in certain sectors where the number of projects is small and the number of private institutions with financial capabilities and technical competences is reduced.

Conclusions

The preceding discussion may lead to the following conclusions:

1. Public-private partnerships are an increasing method of building infrastructures and delivering services to citizens around the world.
2. However, the economic and financial benefits of PPPs are still uncertain and should be the object of more debate to improve the results.
3. If the public-private partnerships are the way governments choose for investments and

service provision, then a predictable framework should be enforced.

4. Governments should realise that the whole process of launching and monitoring PPPs requires a competent and well-resourced public administration.
5. All PPPs should correspond to real needs of the citizens in the present or immediate future.
6. The basis for decision on the model for investments in infrastructures and service provision should be the value for money.
7. The commitments related to PPPs should be transparent and not exceed the financial capabilities of the states in the payments they have to make and the risks they are taking.

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About the Authors

Henrique Diz is a Professor of Economics and Management (retired) at the University of Aveiro, and Professor at University Lusófona of Porto, Portugal. His main research fields are Innovation, Strategy and Regional Development. He is invited professor in Universities in Finland, Japan, Poland and India.

Firing Up the City – A Smart City Living Lab Methodology

Tanguy Coenen, iMinds-iLab.o, Vrije Universiteit Brussel, Belgium,
Shenja van der Graaf, iMinds-SMIT, Vrije Universiteit Brussel, Belgium,
Nils Walravens, iMinds-SMIT, Vrije Universiteit Brussel, Belgium

Abstract

We position Living Labs as a research and development methodology that allows the creation of products and services at the overlap between top-down and bottom-up Smart city perspectives. First, the concept of Living Labs and Smart Cities are introduced and their understanding and implementation are discussed underpinning this study. This is followed by drawing out the two case studies so as to yield insight into the way the Living Labs were conducted, and which is structured along ten phases. We explain how these different phases involved a broad set of stakeholders, from different parts of society such as city employees of local NGOs and city administrators, neighborhood inhabitants, engineers, designers and artists. We also highlight how the collaboration of these different stakeholders gave rise to open innovation in a Living Lab context.

Keywords

Social capital, neighbourhood cohesion, mobility, prototype co-design, Living Lab

Introduction

This chapter yields insight in the development and design of Smart City services by using a Living Lab approach. Two case studies, executed in Belgium, will be presented that were conducted in the context of respectively the Smart Metropolitan Areas Realised Through Innovation & People (SmartIP) and European Platform for Intelligent Cities (EPIC) EU-funded CIP projects. The first project produced ZWERM, a city intervention deploying a game-oriented system to consolidate and activate social capital within urban neighbourhoods. The second project presents the Relocation Service (RS) Application, a mobile application service for expatriates facilitating their relocation from abroad to a neighbourhood of their liking in the city of Brussels, Belgium. Both systems are exemplary for Smart City service design involving multiple stakeholders. More specifically, both were created in a Living Lab setting in which various user types were not only involved in the testing phase, but were involved from the early stages of idea generation and co-design phases. We will concentrate on the aspects of ZWERM and RS that were related to the Living Lab operationalization.

Living Labs

The term Living Lab is rather opaque. In general, it is considered vis-à-vis the kind of innovation that has been approached as a linear process, driven and controlled by the industrial developers of products for the marketplace. Nowadays, scholars and practitioners have acknowledged that innovation can increasingly function as a catalyst for growth and competitiveness. In fact, such a view has been enthusiastically promoted at regional, national and international levels, underpinned by new policy formulations (Edward-Schachter et al., 2012). More specifically, from a more linear understanding it has evolved more towards a network model, involving various partners that support innovation, often involving multiple cycles of innovation activities. This is related to the shift from "classical" innovation to what has been termed 'open innovation' (Chesbrough, 2006). It alludes to an open attitude towards ideas stemming from outside the boundaries of the firm, since innovation can only thrive when a company utilises a network of partnerships beyond its internal resources (Vanobberghen et al., 2013).

This idea of open innovation has coincided with a greater acknowledgment of the role of the user particularly in the development process. While this is not new (cf. von Hippel, 2005), the focus on user input has rapidly changed from collecting customer feedback data such as in labs, to integrating users in the innovation process as active co-producers in Living Labs. Living Labs build specifically on this trend, believing that gaining insight in the user and the usage context is one of the main critical determinants in successful product development processes (Eriksson, Niitamo, Kulkki, & Hribernik, 2006).

The operationalization of the Living Lab distinguishes itself from other approaches (such as usability research) by confronting users with technology (e.g., a prototype or a proof of concept) early on in the innovation process, within their natural or real-life environment, and by regarding users as the co-producer of technology (Ballon, forthcoming; Veeckman et al., 2013). In this view, Living Labs can be seen to create an innovation environment - a kind of research laboratory - bringing together all relevant stakeholders (e.g., research centres, public institutions, companies) and users. In doing so, it allows for the development of a research and development methodology enabling and facilitating the understanding of user experiences from their real life situation towards the new product or service underpinning the co-creation with the development teams.

An important dichotomy in the Living Lab literature is related to the presence of a testbed, in which different stakeholders can test multiple applications (Følstad, 2008). The methodology and the cases that are discussed here are guided by the kind of Living Lab termed "Living Labs as open innovation platforms" rather than "Living Labs exposing testbed applications to the users" (Følstad, 2008). Thus, the presented cases do not deploy, or use reusable technological or user infrastructure.

Living Lab Methodology

Over the past few years, we have conducted multiple Living Lab projects in various Smart City contexts. From this, we distilled the following ten phases that we present here as a Living Lab methodology. They can be used as a guideline when setting up new Smart City Living Labs. The cases presented below describe how these steps have been operationalized and implemented in a Smart City context. The phases are the following:

1. Idea generation
2. Idea selection
3. Co-design
4. 1st Implementation phase
5. Prototype testing
6. 2nd Implementation phase
7. Field trials
8. Evaluation by the stakeholders
9. Lessons learned and dissemination in the form of transferable knowledge.
10. Further market orientation

Smart Cities and Living Labs

Many different interpretations of the term Smart City exist, as defined in e.g., Giffinger et al. (2007) or Caragliu et al. (2009). Recently, Dameri (2013) has coined an increasingly used definition of the Smart City concept, and which is loose enough to allow for additional interpretations:

"A Smart City is a well defined geographical area, in which high technologies such as ICT, logistic, energy production, and so on, cooperate to create benefits for citizens in terms of well being, inclusion and participation, environmental quality, intelligent development; it is governed by a well defined pool of subjects, able to state the rules and policy for the city government and development" (Dameri, 2013: p. 2549).

Depending on the viewpoint one takes, this definition can translate into very different perspectives about the Smart City, of which some extremes are briefly outlined next.

Top down

This perspective contains technologically deterministic ideas, like the "control room" for the city, providing an architecture and ICT-based overview of all activity in the city as well as the tools to (automatically) interact with infrastructures or adjust parameters to predefined optima (IBM, 2009). This idea is mainly endorsed by large private companies such as technology vendors, network companies and the major software industry. They see the potential value to be derived from rolling out their proprietary Smart City technology in large and small urban areas and have convinced several cities of their propositions (e.g., Rio De Janeiro) (Singer, 2012). There are substantial potential benefits tied to having an integrated Smart City solution in a city: many different services and infrastructure systems can be managed from one central hub, keeping oversight on many divergent aspects of life in the city. However, this vision also entails questions of control, privacy and commercial interests, which can hinder innovation and in some cases even have detrimental effects.

Bottom-up

These architectural, infrastructural or top-down viewpoints are contrasted by a more experimental, bottom-up view on the Smart City. In this perspective, innovation comes from the people "using" the city or is at least co-created with citizens, a process that can be stimulated by government. Aptly put by Greg Lindsay:

"The bias lurking behind every large-scale Smart City is a belief that bottom-up complexity can be bottled and put to use for top-down ends — that a central agency, with the right computer program, could one day manage and even dictate the complex needs of an actual city. The smartest cities are the ones that embrace openness, randomness and serendipity — everything that makes a city great" (Lindsay, 2011: n.p.).

Examples of the bottom-up approach can be found in citizen initiatives and (semi)illegal interventions in the public space, such as so-called guerilla bike lanes where citizens unhappy with local biking infrastructure paint bike lanes on the street without authorization (Muños, 2013) or the initiatives referred to as 'tactical urbanism' (Hamdi, 2004). In such a perspective, what defines the Smart City is not the infrastructures or architectures it offers, but the ways in which its citizens interact with the city's affordances as well as with each other.

Meeting in the middle

Against this backdrop, while the Smart City concept remains elusive, it points to an increasing need to develop new ways of looking at the city of the future and to think about structured approaches to provide answers for the diverse and complex questions that companies, citizens and governments face. More specifically, we believe in operationalizing the Smart City as meeting top-down views and bottom-up ones in the middle. This means looking at the Smart City as an enabling platform (Camponeschi, 2011), a meeting place where the public sector, private interest and citizens can come together to generate new value and innovate together, and of which Living Labs are exemplary. These are the emphases we would like to make in the ongoing discussion and operationalization of the Smart City concept. Bringing together stakeholders to innovate in interesting new ways is also key in setting up and executing successful Living Labs.

Case 1: ZWERM

General case description

ZWERM is a city intervention that uses a gameful system (i.e. a game that aims to achieve more than entertainment only) to reach the goal of consolidating and activating social capital. By interacting with ZWERM, people get to know each other and are stimulated to undertake action together that is beneficial for the collective. The ZWERM city intervention took place in two neighbourhoods in the city of Ghent in Belgium. The ZWERM concept was developed in collaboration with multiple stakeholders including personnel from the city of Ghent and the city's inhabitants. 277 out of 1440 people from the selected neighbourhoods actively participated in ZWERM, resulting in a 19,2 % response rate. Evaluation results show that ZWERM was greatly appreciated. More than 80% of the players stated that ZWERM helped them to get to know the people in their neighborhood better, while more than 75% stated that ZWERM induced a sense of community and improved neighborhood cohesion. When asked how many new people were met by participants as a result of playing ZWERM, the average proved to be 14,64 new contacts.

Due to lack of space, we chose not to describe the system, but to focus on the Living Lab process that produced it. An extensive description of the functionalities of ZWERM can be found in Coenen et al (2013) and Laureyssens et al (2014). More information on the system as a whole, including a short video illustrating the field trials, is available at zwermgent.be.

ZWERM as a Living Lab

In this section, we discuss how ZWERM was carried out as a living lab, using the ten steps described above.

1. Idea generation

The ZWERM system was developed as part of the SmartIP EU-funded Competitiveness and Innovation framework program (CIP). In the description of work of the project, the goal of what was to be developed was very broad, stating that we should improve citizen engagement in Smart Cities. A number of project partners were part of the work package in which this was to be done, giving us the ingredients for our future system. These were:

- User research skills provided by iMinds
- An Internet of Things backend system provided by Alcatel-Lucent
- Software development skills provided by iMinds
- Local knowledge of the geographical area (Ghent, Belgium) in which we were to deploy the system, provided by city of Ghent personnel.

The project left us much freedom in what was actually to be created. Therefore, the first step we carried out was idea generation. This was done by means of a crowdsourcing campaign. A description of this campaign and reflections on it can be found in Schuurman et al (2012). In short, citizens of Ghent were asked to submit their "Digital idea for Ghent" on an online platform. Users of this platform could post ideas and could vote on ideas posted by other users. In total, 128 ideas were posted, which after removal of duplicates boiled down to 97 unique ideas.

Whereas the crowdsourced idea list did not supply us with a well-defined and usable idea, it did provide us with a number of guiding topics describing the aspirations of the Smart Citizens of Ghent.

For example, we learned that people asked for concepts that were inclusive, meaning that they should not set the technological threshold for participation too high. Also, a substantial number of ideas were hinting at applying gaming principles to city applications and placing physical computing devices (like kiosks) in the public space.

2. Idea selection

Further idea selection based on the input of the idea generation phase was performed in workshop sessions in which new ideas were generated and discussed. Participants of these sessions were the project partners and a broad and openly recruited set of interested citizen. During these sessions, the 128 ideas were rated on the dimensions of feasibility and originality. This again did not provide us with a decisive clear list of clear-cut ideas, but rather allowed us to better gauge the public interest within the frame of our project and to focus on a number of embryonic concepts that seemed promising.

3. Co-design

Based on the ideas, generated in phases 1 and 2 and taking into account the literature on Smart City engagement, a concept slowly matured. It was based on the popular concept of gamification and would seek to impact social capital. Multiple concepts were discussed, among which a backpack full of sensors that would be lent to city inhabitants and a digital postcard of a certain area on which actual sensors readings (temperatures, humidity, CO2 level,…) would be placed. This concept creation was done mainly with the project partners, in an effort to connect all the dots of the technological and conceptual puzzle. The concept that was selected was to create a gamified system with interactive public space furniture that would impact social capital and would have a low participation threshold and that would involve a competition between two neighbourhoods.

Figure 1: a co-design workshop in the SmartIP project

However, we realised that we did not have the necessary skills to design and create the public space furniture. Therefore, we contacted a designer who also works as a researcher on public space interactive interventions. A number of designs for public furniture were made and discussed with the project partners. Next, city of Ghent personnel identified individuals that played a key role in activating the selected neighbourhood's community. These people were presented with our preliminary concept sketches and provided us with extensive feedback.

Once the concepts were rectified, we designed the software and hardware architecture of the system. This allowed us to establish a clear division of work within the project consortium. The next step was to create the Graphical user interfaces for the main end-user oriented components. A first version was created as wireframes, containing an overview of the screens that would be presented to the user. To find out if the concept was understandable, we conducted paper prototyping tests with friendly users, yielding feedback that allowed us to refine the GUI design.

Various designs were created for the public space physical structures. In order to be able to deploy these, we needed permission from the city of Ghent's urban planning department, resulting to many changes in the design of the physical structures.

4. 1st Implementation phase

With clear overview of the architecture, and the GUI we were able to create a first interactive prototype. We created a minimum playable prototype in which we could test a number of the core elements of our setup for technical robustness, usability and potential for engagement. In this implementation phase, we deployed a prototype consisting of check-in mechanism and a number of missions. We did not concentrate on the system's aesthetics, as this would have cost too much time.

5. Prototype testing:

The in-house Living Lab tests were done at our own research facility for 3 weeks. We created a mini-version of the ZWERM system, without physical structures, RFID cards, smartphone interface, etc… Still, we learned a lot from this. Our main lesson was that the core check-in game mechanic was valid, as people got highly engaged by the game. Another thing we learned was that the concept in its full depth took a while to communicate and that we therefore needed to put some additional effort in the way we would explain it during the field trials. These and many other insights were gathered interviewing and observing our colleagues.

6. 2nd Implementation phase

Based on what we learned from the prototype tests, we were able to refine the GUI wireframes. To make sure that we knew exactly what to build, the wireframes were sent to user experience designers, who provided us with complete mockups of every GUI screen. This gave our programming team the missing information they needed to build the system's software, using SCRUM agile development sprints. In addition, the hardware casings for both the physical structures were created during this phase.

7. Field trials

Once the system was developed, we performed in-house testing to filter out the main bugs and launched the field trials in the selected neighbourhoods. These required a lot of hands-on work, as the physical structures contained hardware that needed regular maintenance. The field trials ran for four one-week campaigns in the two selected neighbourhoods and saw a large amount of user activity, producing a large set of qualitative and quantitative research data.

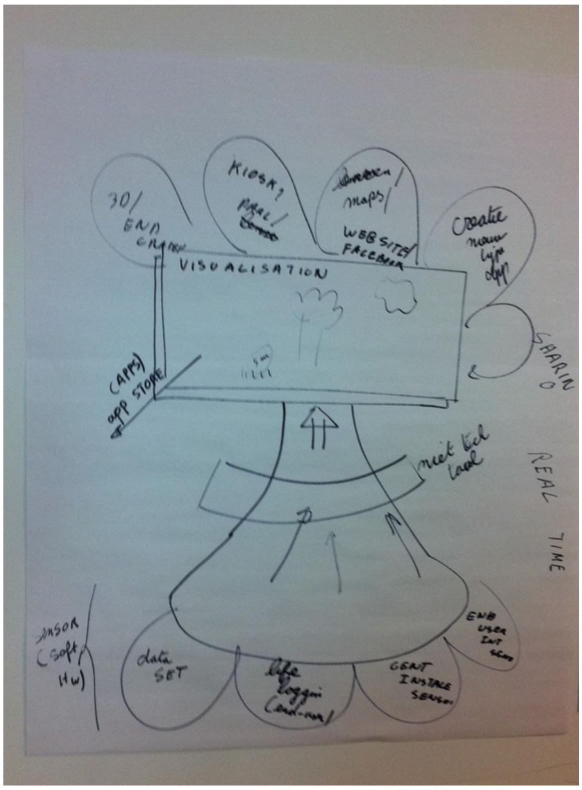

Figure 2. Poster of a discarded co-design concept, of real-time digital potcards containing local sensor databourhoods and saw a large amount of user activity, producing a large set of qualitative and quantitative research data.

8. Evaluation by the stakeholders

The actual outcome of the field trial exceeded our hopes. Whereas in the first 2 campaigns, participation built up slowly, the last two campaigns saw a massive surge in activity. We gathered data using a multi-method research setup involving:

- Participatory observations: a researcher would go to the trees, mingle with the crowd and play along. By talking to the players and observing their behaviour, a lot was learned about people's perception of ZWERM and potential points of improvement.
- Survey: a survey was conducted after the game to find out how people had perceived ZWERM and to get some measure of the degree to which the research objectives - consolidating and activating social capital - had been achieved.
- Server log data: every action that was undertaken by a player was logged on the server. This gave us longitudinal data to analyse.

9. Dissemination in the form of transferable knowledge.

From the data we collected, we were able to draw a number of conclusions. A first Interaction Amplification Framework was created, to describe the way in which the different components should be placed in the physical space (Lauereyssens et al. 2014). In addition, we developed a Gameful Social Activation Framework (GASF) that is yet to be published. Both efforts represent a contribution to the design research discipline, which investigates a class of systems and proposes guidelines for the creations of new systems of this class by analysing collected data.

10. Further market orientation

By disseminating the results at academic and non-academic events, we learned that there were other possible applications of the ZWERM concept. Our server log data and survey data told us that the solo and combo check-in were the most popular features of ZWERM. These proved to be very simple, inclusive, yet fun mechanisms for engaging people in a community and getting them to know each other. Such increased community involvement emerged as an objective that would be useful in many other social contexts. One possible application would be the bridging of knowledge silos in large organisations. These are all compartmentalised into departments, of which the employees tend not to talk to each other enough. Deploying a system like ZWERM could allow these knowledge silos to be bridged. We were contacted by one of the largest Belgian banks to deploy a system based on ZWERM in all of their administrative centres, for 7.000 employees. Another possible application proved to be events like conferences, where people could do with some social lubrication to engender the professional networking contacts that are so highly valued. Multiple event conference organisers contacted us to deploy a concept based on ZWERM during their events. Finally, we were contacted by two separate parties who wanted to create new hyper-local community-based energy production systems (solar panels, wind turbines,...). In order to build such systems, a community is necessary. We were asked how ZWERM could be used to build the communities that could then carry such initiatives.

Figure 3: Screenshots of the EPIC relocation service smartphone application

Case 2: Relocation service application

General case description

In the case of the Relocation Service (RS) application, developed as part of the EPIC EU-funded CIP project, the focus was on co-designing a mobile application service for expats to facilitate their relocation from another country to a neighbourhood of their liking in the city of Brussels. The overall findings, involving over 254 users, indicated that over 70% would use this service in an actual relocation situation. User feedback indicated that it offered a more robust and extensive service to learn about unknown neighbourhoods and their local community than existing services offered by existing property agencies. In addition, most users said that they would be interested in paying a small fee for this service if it were available.

Due to lack of space, we chose not to describe the system, but to focus on the Living Lab process that produced it. A complete description of the RS's functionalities can be found online in van der Graaf and Vanobberghen (2013) and Vanobberghen et al (2013).

The relocation service application as a Living Lab

1. Idea generation

The EPIC project was more focused in its objectives, centered around the development of a Smart City cloud platform where various (globally developed) services could be connected and repurposed locally. The RS was one such service. Initially, only a web component was foreseen, i.e. an application to learn about a city's available properties by virtually exploring houses and neighborhoods from any location in the world. From initial interviews with various local stakeholders and expats, the idea to also develop a mobile component emerged, supporting users in their first real explorations of the city. This would be done while visiting a shortlist of candidate properties found via the web application or finding new ones on the go.

2. Idea selection

Based on 23 interviews, a first selection was made to underpin what a mobile component should look like. In particular, the kinds of information, sponsoring mechanisms (e.g., ads from insurance or financial institutions), and social aspects (such as possibility to 'like' a property) could be designed. Due to the great variety of ideas, the next step was to enter a co-design phase to pinpoint the most important aspects.

3. Co-design

Four paper prototyping sessions with 7 prospective users emphasized the heterogeneous experience of relocating as it is impacted by three factors:

1. the help and information expats have or do not have at their disposal (e.g., assistance from a relocation agent in the city paid for personally or by the employer or an HR-office).
2. the time frame within which they actually have to relocate.
3. whether they relocate on their own or with partner and/or children.

From the paper prototyping sessions, we distinguished three kinds of 'expat-personas' and two key search options.

4. 1st Implementation phase

Based on the co-design phase, the first functionalities we identified as important to implement were:

- Search a house
- Browse house search results
- View a house's details
- View POIs around a house
- View POIs around a user's location

In technical terms, we devoted some time to finding out how to pipe the data, coming from different local data sources, through IBM's Smarty City cloud platform. In addition, we figured out how to consume this data using a smartphone app.

5. Prototype testing

A survey (N=21) was conducted to test the first set of features. Key user feedback focused on essential GUI improvements, access to personal favorites and loading speed increases. The main functionalities that were identified as needing priority focus included:

- a fully renewed interface
- connecting to a renewed set of mobile web-services which were fully authenticated
- providing access to favorites
- POIs "around me now" showing their distance to the user for easy reference
- Google street view integration to offer an augmented experience
- implementation of a caching mechanism so not every search or call for POIs triggered a request to the web-services.

6. 2nd Implementation phase

Based on this feedback, a new interface was designed and implemented, mobile web-services were rewritten to be fully authenticated and personal user favourites were made accessible. A caching mechanism was implemented storing search and POI data on the device and updating it whenever a connection was made. This greatly reduced the amount of times the app needed to communicate with the server, providing an increase in speed and battery life. Furthermore, POIs now showed their distance to the user's current location and could be viewed through Google Street View.

7. Field trials

In order to better understand the RS in a real-life setting of the city of Brussels, a set of participant observation sessions were organized (March 2013) with 7 EU-inhabitants who just started a job in Brussels and were still looking for a new place to live. The participants were observed by the research team while using the iPhone app and walking around in Brussels. They were asked to comment on their actions. The sessions typically lasted approximately 1,5 hours. Notes and photos were taken and clicking patterns were logged. In addition, the RS application was made available online for download by any interested person (N=254). The overall findings indicated that the application generated a particular urban awareness that can be managed by new citizens such via the favorite function, rather than through a mere understanding the city and house search as a (transitory) destination in itself. In addition, the application also mediated this awareness via its GPS function, informing new citizens about certain nearby properties for sale or rent, or points of interest such as a park or swimming pool. In this way, the application not only mediated but engaged expats to act and interact with the urban space, thereby highlighting the opportunity to seamlessly integrate the surroundings and set objectives with ones everyday needs and interests. Finally, the application allowed the user to control and check data in the description of properties or about neighborhoods or municipalities. This data about neighbourhhoods and municipalities was obtained through public "open data" sources.

8. Evaluation by the stakeholders

Interviews and demonstrations with the stakeholders (e.g., local admin, real estate agency, financial and insurance sector) suggested that the RS had potential to be taken-up because its underlying idea and design was found to be useful and attractive. Apart from certain legal or financial constraints, test users deemed that changes and improvements were necessary. Many comments were either technical (e.g., the pilot was in their opinion still too slow to use) or referred back to earlier comments about usefulness and content. Nonetheless, stakeholders evaluated the prototype as valuable, but as something that still needed to be further developed. All test users encouraged us to continue the work, since it addressed a clear need within the expat community and had the potential to complement existing activities.

9. Dissemination in the form of transferable knowledge.

The main findings that resulted from Living Lab operations and management are presented in a white paper (Vanobberghen et al., 2013). The lessons were taken up in the form of a proof of concept for the city of Tirgu Mures in Romania.

10. Further market orientation

As a result of showing the prototype to the test users and the project partners, interest was sparked in bringing something similar to the market. It proved potentially interesting to offer a hyper-local service that would position itself in the increasingly open world of local data. It was found that finding out what types of data existed in a certain city was a task in itself, that could be sold as a commercial service. In addition, offering a service that would bundle these datasets was perceived as potentially valuable.

Discussion and conclusion

We have discussed how we conducted two Living Lab projects in Smart Cities. The presented methodology was tested in Smart Cities trying to meet in the middle of the top-down and the bottom-up Smart City perspectives. In ZWERM, the top-down perspective was represented by the presence of City of Ghent personnel. They were instrumental in steering the direction of the project. For example, they requested that the focus should not be on reporting urban issues that needed fixing, like is done in systems like FixMyStreet, because this was not innovative enough. Also, we were told that the system should not create the perception that the provided user-generated data would effectively be acted upon by the city administration.

The bottom-up approach towards Smart Cities was represented by including citizens in as many phases as possible of the design, development and evaluation phases. Although citizens were instrumental in shaping the ZWERM's outcome, their role could have been even greater, by working more with DIY technologies supporting tactical urbanism or by working even more with local citizen organizations. This would have brought us even closer to the grassroots, as the systems would not only be co-designed, but also co-produced by citizens. This approach is taken currently by certain projects that focus on "hackatons" to foster local co-production.

The RS case can be said to lean towards the top-down approach. Here, the goals of the project were already more well-defined. Therefore, the initial phases in the methodology, focusing on idea generation and idea selection, were less intensive than in the case of ZWERM. However, we believe it is important to include these steps in the methodology if it is to guide the development of Living Lab projects in a "meet in the middle" philosophy, as a best of both worlds approach. In such an approach, processes can be implemented for involving both the voice of citizens and local grassroot organization to represent the bottom-up perspective and the voice of government and companies to represent the top-down view. By combining both perspectives in Living Labs, we believe it is possible to develop systems that effectively fire up the city.

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About the Authors

Tanguy Coenen (PhD,Vrije Universiteit Brussel) is a senior research at iMinds iLab.o and the Vrije Universiteit Brussel. He focusses on software prototyping in Living Labs and has acted as technical lead in many EU-funded Smart City projects. He has conducted research on gamification, e-leaning, social media and knowledge management.

Shenja van der Graaf (PhD, LSE) is a senior researcher and heads the 'Code, Commodification & the City' cluster at iMinds-SMIT, Vrije Universiteit Brussel (Belgium). Her current work is concerned with social, economic, and policy issues arising from innovations associated with the ICTs. Specific lines of inquiry include management of technological innovation in firms, cities and communities; (new) media users and 'cultures of expertise'; and, mediation of social and economic life, theoretical perspectives.

Nils Walravens started working for iMinds-SMIT in August of 2007 as a researcher in the Market Innovation and Sector Transitions unit. His main expertise is in the field of business modelling research in both the mobile and media industries and he has experience in mobile apps research, Smart Cities and platformisation in the media and mobile industry.

Engaging Individuals in the Smart City Paradigm: Participatory Sensing and Augmented Reality

Luis Sanchez, Veronica Gutierrez, Jose A. Galache, Pablo Sotres, Juan R. Santana & Luis Muñoz, University of Cantabria, Spain

Abstract

Smart City concept relates to improving efficiency of city services and facilitating a more sustainable development of cities. However, it is important to highlight that in order to effectively progress towards such smart urban environments, the people living in these cities must be tightly engaged in this endeavor. This paper presents two novel services that bring the Smart City closer to the citizen. The Participatory Sensing service we are proposing exploits the advanced features of nowadays smartphones to make the user part of the ubiquitous sensing infrastructure over which Smart City concept is built. The Augmented Reality service is connected to the smart city platform in order to create an advanced visualization tool where the plethora of available information is presented to citizen embedded on her/his natural surroundings. These services have been developed and deployed together with a real-world smart city deployment that will be also described. Finally, a brief description of the smart city platform on top of which these services are built will also be presented.

Keywords

smart city; participatory sensing; augmented reality

Introduction

Smart cities exploit synergies between the ubiquitous sensing technology and their social components to enhance the quality of life of citizens, while improving the efficiency of the city services. In this sense, the Smart City concept (Schaffers et al., 2011a; Nam & Pardo, 2011) has been typically associated to an eco-system where technology is embedded everywhere so that the different city services (e.g. traffic, water, sewage, energy, commerce, etc.) are highly improved by exploiting the interconnected information and actuation capabilities that this technology provides. However, sometimes this advanced technological environment leads to disregard the fact that the ultimate aim of the Smart City concept must be the citizens living in urban areas focusing too much on the technology and missing the engagement of the society with this paradigm. Smart cities are not simply those that deploy ICT. They combine new technology with smart new ways of thinking about technologies' role in organization, design and planning. As smart city initiatives are planned, ways that technology can create new urban user experiences must be envisioned. Thinking about the

Smart City as a holistic system and considering ways that new systems can result in positive behavioral change needs from citizens' engagement from the very first moment of the city smartening transition.

This paper presents an architecture that, following Internet of Things (IoT) precepts (Atzori, Iera, & Morabito, 2010; Vermesan et al., 2011), enables the creation of a ubiquitous sensing infrastructure within the scope of a Smart City aiming at improving city services efficiency. This architecture does not only tackle the main challenges pertaining to the infrastructure management and data handling but also defines the necessary middleware that enables seamless access to such infrastructure for the development of value-added services. This latter aspect is what mainly motivates this article as two novel services have been developed on top of an urban deployment (in the city of Santander, Spain) of a large-scale IoT infrastructure which supports the provision of impact-generating smart city services directly perceivable by all the Smart City stakeholders (Galache et al., 2012).

Augmented reality (AR) systems have recently emerged as a powerful visualization tool which augments real world elements with digital information. The proliferation of powerful smartphones has accelerated the adoption of AR also in mobile environments. Additionally, the wide deployment of Wireless Sensors Networks (WSNs) will give the possibility to integrate AR systems with sensor data and create sophisticated visualization systems. Moreover, a particularly important aspect from the AR is its ability to make the user to feel naturally surrounded by the technology thus providing a perfect eco-system for the user to engage with the Smart City concept. In this paper the Augmented Reality service that has been developed for bringing the information generated on the aforementioned Smart City infrastructure will be described. In this sense, main insights of the service architecture as well as details of the developed mobile App will be given.

Mobile phones have evolved from devices that are just used for voice and text communication to platforms that are able to capture and transmit a range of data types (image, audio, and location). The adoption of these increasingly capable devices by society has enabled a potentially pervasive sensing paradigm. A coordinated participatory sensing system engages individuals carrying mobile phones to explore phenomena and events of interest using in situ data collection and reporting. The Participatory Sensing service that will be described in this paper exploits the ubiquitous sensing enabling infrastructure developed. Users can subscribe to services such as "the pace of the city", where they can get alerts for specific types of events currently occurring in the city. Finally, users can themselves also report the occurrence of such events, which will subsequently be propagated to other users that are subscribed to the respective type of events, etc.

The paper is structured as follows. Section 2 presents a thorough description of the smart city IoT infrastructure deployed in Santander. This infrastructure is the baseline on top of which different smart city services are being provided, specifically the two services described in this paper are supported by it. In Section 3 the architecture and platform on top of which these services have been developed will be briefly sketched. Particular emphasis will be put on the part of the architecture which deals with the service development framework. In Section 4 the Smart City Augmented Reality service that has been implemented will be described in detail. The service architecture as well as the implementation insights will be thoroughly presented. The Smart City Participatory Sensing service will be described in Section 5. As previously mentioned, this service engages citizens on reporting events which are treated as rich pieces of sensed information. Finally, conclusions will be derived in Section 6.

Santander Smart City IoT Infrastructure

The objectives of the IoT infrastructure deployed in Santander are two-fold as well as concurrent. As a testbed, it enables experimental assessment of cutting-edge scientific research. However, this testbed goes beyond the experimental validation of novel IoT technologies. It also aims at supporting the assessment of the socio-economical acceptance of new IoT solutions and the quantification of service usability and performance with end users in the loop. For instance, it simultaneously supports the trial and subsequent provisioning of smart city services. To attract the widest interest and demonstrate the usefulness of the SmartSantander platform, the deployment of the IoT experimentation infrastructure has been undertaken to realise the most interesting and impact-generation use cases (Sanchez et al., 2013). In this respect, application areas have been selected based on their high potential impact on the citizens, thus enabling the execution of extensive experiments to obtain insights into the uptake of IoT-based services deployed in a live environment. Also taken into consideration in the selection of application use cases are the diversity, dynamics and scale of the IoT environment. All these aspects increase the potential of the testbed for the evaluation of advanced protocol solutions.

The IoT experimentation facility deployed in Santander has been settled on a cyclic approach with the three planned phases already undertaken.

The objective of the first cycle of deployment was to create a meshed WSN on fixed locations that would serve as a testing environment for the experimental validation of advanced WSN-related mechanisms. The deployment also influenced by the city of Santander smart-city service requirements and strategy, focused on three geographical areas of significance to the smart-city services. To achieve the maximum possible impact to the citizens, the deployment process intentionally accomplishes a concentration of IoT devices in the city center (a 1 Km2 area). This area has the highest IoT node density in Santander and frequent usage provides insights into the acceptance of IoT-based services running in live environments.

Figure 1. Santander city center development excerpt view

Figure 1 shows an excerpt view of the Santander city center deployment. The different icons represent the deployed nodes (i.e. Carbon Monoxide – CO –, light intensity, noise, temperature, and car presence detection sensors). The deployment includes clusters of wireless sensors and gateway devices acting as cluster heads.

Once the areas for the deployment were decided, the next step in the deployment process was to specify where to physically install the devices. In this sense, the key factor influencing the decision was ensuring a viable power supply to all the devices. Although, WSNs are typically considered autonomous in terms of power needs, this assumption does not reconcile with the envisaged high-frequency multi-user usage model of our platform. Energy autonomy is achieved through the use of long-lasting batteries and most importantly, energy efficient mechanisms. However, testbed experimentation requires frequent node-software updates, which impose a stiffer power consumption penalty on IoT nodes than can be realistically met by batteries alone.

A hybrid solution to IoT node power requirements was adopted to minimize the infrastructure's energy consumption signature on the power grid, but ensure the survivability of its experimentation nodes. To fulfil the need for proximity to a power source, sensor devices were attached to public lampposts (as illustrated by the picture in Figure 2). The sensor devices are also endowed with rechargeable batteries and a charging circuit. Thus, daylight operation of the nodes (lampposts turned off) draws power from the batteries which are charged at night when the lampposts are turned on. Nightly operation of the nodes relies on the power from the lamppost. This solution guarantees power supply even under energy-hungry experimentation scenarios. Corresponding electrical adaptation and protections (transformer, fuse and differential protection) were added in order to obey municipal regulation.

Although this solution was feasible for sensor nodes supporting the environmental monitoring service, proximity to permanent power supplies for parking sensor nodes is impossible due their deployment location (buried under the asphalt, see Figure 2). Thus, due to their exclusive reliance of batteries, power consumption on these nodes is kept minimal using energy efficient mechanisms similar to those presented in commercial products (http://www.nedapavi.com/products/sensit/sensit.html, http://www.tst-sistemas.es/en/solutions/parking/, http://www.streetline.com/parksight/). This guarantees a device lifetime of over 3 years. Experimentation over these nodes is restricted only to accessing car-presence detection information.

Gateway devices have other deployment peculiarities in that they require a constant power supply and connectivity to the Internet. The solution was to install most of these devices at municipality premises located along the area to be covered. These premises are connected through a fiber-optic ring which allows GWs to be connected to a high-capacity backbone network. Where no such municipality premises were available, access to the Internet is achieved through WAN connectivity via a 3G telecoms network interface.

The first cycle of IoT deployment yielded 740 points of presence in the city. Each point of presence is equipped with several sensors making a total of more than 50 noise sensors, 600 temperature sensors, 500 light intensity sensors and 30 CO sensors. Additionally, 390 nodes with car presence detection modules have been installed in parking bays and 23 GWs have been installed to ensure connectivity between the IoT node tier and the server tier.

In the second cycle, three additional fixed-node clusters totaling approximately 50 IoT nodes were added to the infrastructure. These clusters support the smart irrigation use case and offer sensing capabilities via 45 temperature and relative humidity sensors, 25 soil moisture and soil temperature sensors, 4 weather stations with solar radiation, atmospheric pressure, anemometer and rainfall sensors, and 2 water flow sensors.

The second cycle also improved node heterogeneity with the deployment of 150 mobile devices on top of public transport buses, municipality fleet vehicles and taxis. These nodes provide useful mobility patterns for experimentation as well as support environmental monitoring service. These devices are equipped with sensors for detecting air pollutants such as Nitrogen Dioxide (NO2), CO, Ozone (O3) as well as detection of particles in suspension, temperature and air humidity. Most importantly, they are also equipped with GPS so that all their observations come geo-localized and they also report speed and course of the vehicle. Besides the enhanced experimentation possibilities, we envisage these nodes to serve multiple application domains such as smart public transportation management and traffic conditions assessment.

Further, to support experimentation based on alternative technologies and facets of the IoT paradigm, 2,000 Quick Response (QR) and Near Field Communication (NFC) tags (cf. Figure 2) have been deployed over the city (at touristic Points of Interest (POI), bus stops and municipality's premises). These collectively support the operation of the augmented reality smart-city service.

Figure 2: Details of sensor nodes installed in Santander

Finally, citizens' smartphones are also part of the testbed. A Participatory Sensing mobile app has been developed within the SmartSantander project to enable these devices to send sensed physical measurements as well as mobile phone users' observations (text, images and video).

Last but not least, during the third and last cycle deployment was dedicated to extend two of the already existing deployments. In this sense, although the deployment of mobile sensors of the previous phases was very representative as it covered the majority of the city with special emphasis at the Santander city center, for this third phase it were necessary and appropriate to extend the Environmental Monitoring service to other areas beyond Santander area. Hence, the nodes were deployed on public buses covering lines that interconnect main cities in Cantabria with Santander. Additionally, another 330 car presence detection modules have been deployed at parking lots on the city center streets. Interestingly, 30 of these nodes support authentication of the parked vehicle so they have been used for controlling restricted access lots such as handicapped-reserved areas.

Smart City Platform

This section, first, elaborates on the requirements for providing a rich IoT based smart city environment and addressing many open research challenges in the area of IoT platforms. Based on these requirements, it provides an overview of the architecture of the SmartSantander smart city platform with particular attention to the platform subsystem addressing the service provision aspects.

Design considerations

Heterogeneity: Future Internets of Things will consist of a wide variety of devices integrated with other Future Internet (FI) infrastructure and service provisioning platforms. For reasons of applicability, it is expected that the development and evaluation of protocols and other IoT technologies be undertaken under conditions that is representative of the degree of heterogeneity inherent in the Internet of Things. In this respect, the SmartSantander provides a multi-tier architecture that encompasses the most relevant device tiers of IoT systems. The IoT device tier, in particular, offers a diverse set of heterogeneous IoT nodes (sensors, actuators, QR and NFC tags and mobile-phone-based sensing-platforms) connected via different network technologies, with different mobility (fixed or mobile), and with different sensing/actuation modalities.

Mobility: The IoT is composed of fixed and mobile devices which can also interact with each other in real life scenarios. While some indoor testbeds offer robot-controlled mobility, it is often difficult to reproduce real life mobility patterns in such testbeds. SmartSantander therefore provides support for realistic mobility by deploying a part of the infrastructure on moving real world entities, such as buses, public service vehicles or taxis. Furthermore the mobility of users is opportunistically leveraged by allowing the smartphone of a citizen to report information captured in a participatory manner (Burke et al., 2009).

User support and end user involvement: The deployment of an IoT facility in the heart of a city and the considerable costs involved motivate the exploitation of the facility for the development and evaluation of IoT enabled Smart City services and applications targeting developers of commercial Smart City services and applications. The involvement of concrete end users adds another dimension to the evaluation capabilities of the platform by allowing not only the assessment of technical performance of IoT solutions, but also their user adoption and social impact.

Reliability: Having in mind the purpose of the infrastructure, in particular that it is intended to be used for service provision, reliability of the complete system represents an important requirement to ensure smooth and uninterrupted operation.

High level architecture

This section presents the architecture that forms the basis for the deployment of services on top of a Smart City IoT platform. In this sense, it certainly exceeds the requirements imposed by the two Smart City services to be presented in the following sections. However, for the sake of completeness, it is important to make a brief sketch of the main architecture blocks for allowing a better understanding of the services' architecture, design and implementation.

The proposed Smart City IoT platform is realized by a three tiered network node architecture, which consists of an IoT device tier, a gateway (GW) tier and server tier.

The IoT node tier provides the necessary sensing substrate consisting of IoT devices. These devices are extremely heterogeneous, from diverse mote platforms (typically resource-constrained in terms of power, memory and energy availability), RFID readers and tags as well as more powerful platforms such as mobile phones with short range communication capabilities.

The gateway node tier links the IoT devices at the edges of the network to a core network infrastructure. The GW tier devices are typically more powerful than IoT nodes but at the same can still be based on embedded device architectures.

The server tier provides more powerful server devices, with high availability, which are directly connected to the core network infrastructure. The servers can be used to host IoT data repositories and application servers that can be configured to realize a variety of different IoT services and applications.

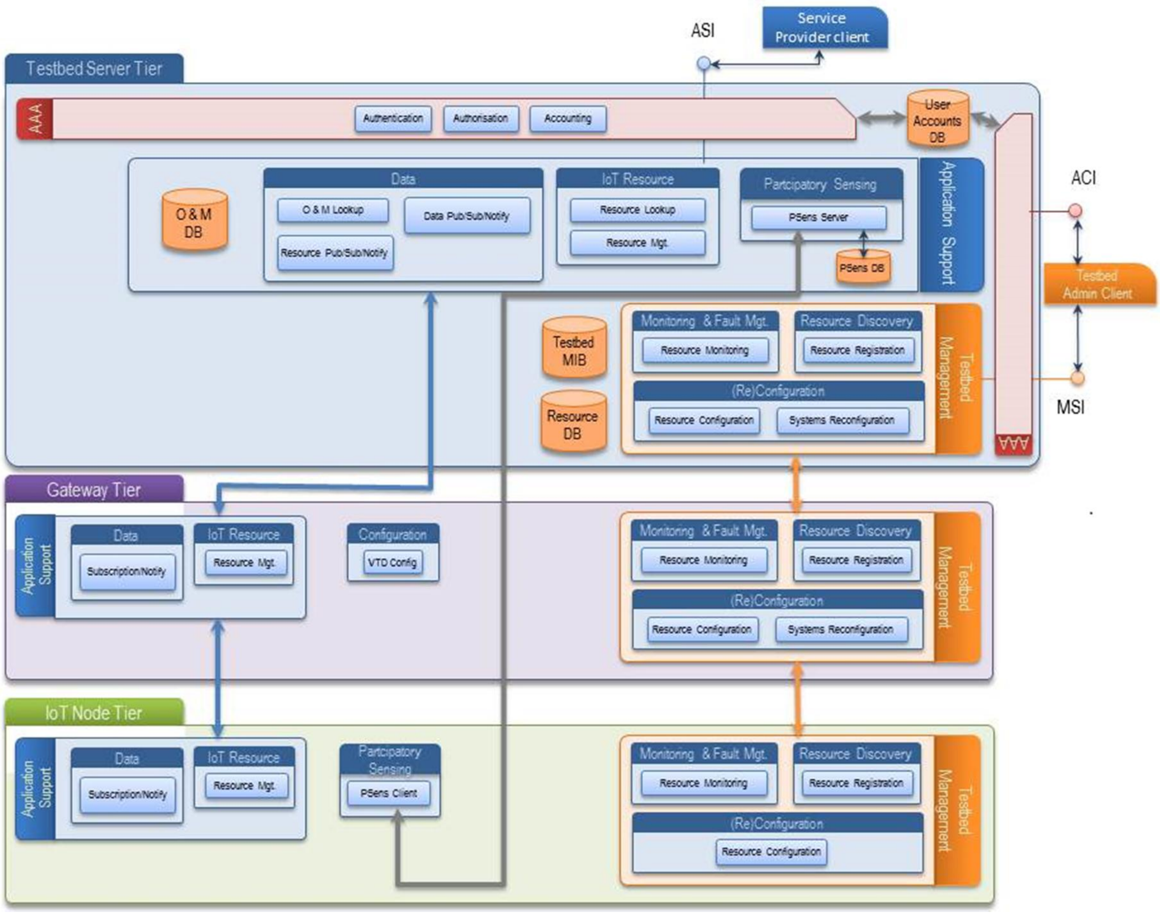

Figure 3. Smart City IoT platform

Figure 3 provides an overview of the software architecture, showing the different subsystems and service functions of the testbed observation and management plane. The architecture distinguished between three subsystems: 1) Authentication, Authorization and Accounting (AAA) 2) Testbed Management and 3) Application Support.

The AAA subsystem is common for all user groups and controls the access to the testbed functions. Its services are exposed via the Access Control Interface (ACI). Depending on user privileges the other subsystem functions can be invoked.

The management support interface (MSI) exposes the service functions of the management subsystem and is typically used by the system administrators. It provides access to functions such as user accounts, testbed resource discovery and configuration as well monitoring and fault management.

The application support interface (ASI) offers a wide range of data management functions that can operate on information retrieved from the deployed sensors of the IoT node tier including citizen provided information through participatory sensing on mobile phones.

The Application Support System (ASS) is intended to provide the functionalities that can facilitate the development of services either for experimentation or final service provisioning.

First of all, through the IoT Management component blocks, users are notified when either changes to the resource descriptions occurs or when resources matching certain criteria appear or disappear. This component, at the server tier, will be receiving notifications from GW nodes, and also checking the Resource DB in order to keep track of infrastructure dynamicity. At the GW nodes and IoT nodes, it is expected that the Resource Management modules update the descriptions and register resources respectively when needed.

The Data Publish/Subscribe/Notify components will provide the mechanism for applications based on the observations and measurements provided by the resources to get such observations as soon as they come. The way of working is the following:

1. The application will subscribe to the Data Pub/Sub/Not component provided by the testbed server expressing filter criteria. This filter can contain simple or complex conditions involving several resources and current or historical measurements.
2. The resources in the IoT nodes or IoT Gateways will generate the information that will be stored in the O&M DB and also sent to the Data Pub/Sub/Not module.
3. Every time an observation is provided, it is checked against the filter criteria and if required a notification is sent to the subscribed applications.

The O&M Lookup allows application to ask for information stored in the O&M DB. This might refer to the current value of an observation or to historical data.

Finally, the Resource Lookup function enables applications to search for resources stored in the Resource DB. This allows users to find resources matching certain criteria like location, type of information provided, available functions, IoT node hardware and software capabilities, etc.

Santander's Augmented Reality Service

In Santander, as in many other cities, there is a glut of information that may be of interest for citizens and tourists but, which may not be readily accessible. The reason for this include the heterogeneous mix of data sources producing data in different formats and the lack of a uniform data access specification/layer that would make data access easier. Information about transport, shopping, leisure activities, cultural agenda and so on is available in many different sites and is unknown to end users. To unify all these data sources and present them in a context-sensitive, location-aware manner to end users, the SmartSantanderRA app was developed.

With an AR application users can define their own preferences (language, touristic places to visit, monuments, etc.) and have an interactive context-sensitive experience visiting the city rather than using traditional standalone applications. The video stream produced by the smartphone camera is presented to the user of the AR mobile application which augments the live feed of the camera with virtual objects (mainly digital content, video, texts, and photos) of the POI, based on the current position of the device thereby creating an augmented view of the reality.

For each POI, the app provides a description of the place or reference image to be used in the AR view and the type of content to be superimposed. The content itself (3D model, image, videos, audio, etc.) is stored in the AR Server. Moreover, this server is in charged off getting all the real-time data from the Santander city Council legacy System (transport Services, city agenda, etc.). Pre-recorded multimedia content and a Multilanguage portal accessible from any terminal could be created to categorize the contents and make it easy the access to them.

As an illustration of the type of service the Augmented Reality application supports, the service provides a touristic experience through its “stroll in the city” mode. With the application in this mode, the tourist will receive information on specific monuments in his preferred language as he/she strolls around the city. This, in general, enhances the serendipity effect of the tourist visit.

Furthermore, placing NFC tags on certain shops in the city provides new opportunities for shops to build or strengthen customer relationships. The shops can explore the relationship between physical presence and the web. The users can get specific information about the shop, for instance, opening hours, contact, special offers, accessibility in the shop, etc.

From the City Council perspective, the placement of NFC tags in strategic places in urban facilities will provide location-sensitive information to the citizens. Also the use of location-aware applications using Augmented Reality technology allows the municipality to provide better touristic services to visitors. For the municipality, observations sent to the smart city platform by the AR applications will allow the collection of information about how many people visit the different POI, or at least is in the nearby areas, origin from that people, seasonality, etc. Based on this information, they can improve the touristic offer of the city, adapting the cultural events and activities during each season.

The SmartSantander platform offers to the augmented reality scenario the possibility of generating observations with relevant data to generate new services. These observations include:

- Position information: based on smartphone sensors such as GPS, digital compass and accelerometer (location based tracking) or tags reading or with a combination of the two techniques. In this sense, the AR application will support both QR codes as well as NFC tags.
- Users Preferences: the language, the kind of POI searched the individuals POI visited.
- Devices: device capabilities and OS.

Figure 4 shows the functionalities or services the user can interact with.

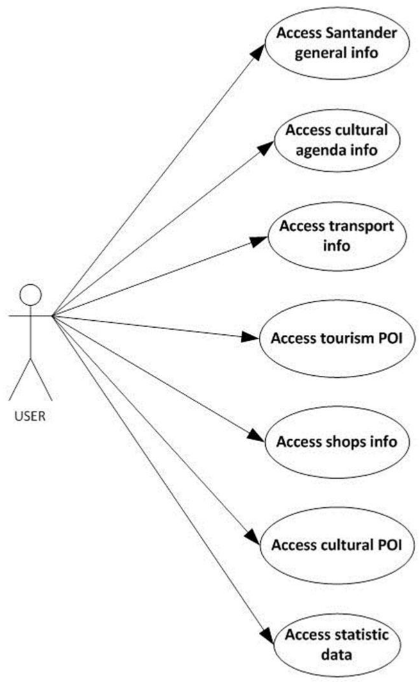

Figure 4. Augmented Reality – Citizen Use Case diagram

To realize this use case, two software components were developed: a mobile application (SmartSantanderRA) for the users and a server component (Augmented Reality Server, AR Server in short) which runs the service business logic and bridges the application with the SmartSantander platform.

The AR Server is responsible for collecting all the information needed from other external organizations servers that collaborate with the city council. For this purpose, it stores a database with all the POI’s static data. Moreover, this server accesses the legacy system (services previously developed by the Santander City Council) to get the real time data from the public transport services, city agenda, city news, traffic webcams, etc. The communication between the Augmented Reality Server and the Legacy System is based on XML Web Services (using SOAP as transport) and XML for parsing data.

The SmartSantanderRA application (https://play.google.com/store/apps/details?id=es.unican.tlmat.smartsantanderra, http://itunes.apple.com/us/app/smartsantanderra/id541890402?l=es&mt=8) provides information on all areas of interest in the city. The data is structured in two groups:

- Augmented Reality data: The data showed is based on the current position of the device. The app gets the data of a configurable number of POIs closer to the current position.
- City General data: The data showed is independent of the position of the device.

Figure 5 shows some screenshots from the application.

Figure 5. SmartSantaderRA application screenshots

The application currently offer information on five different topics, namely tourism, shops, cultural agenda, transportation and museums, numbered 2 to 6 in Figure 5. Additionally Santander's general information (independent from user location) is also accessible. Here the user can find info about the city news, beaches info (with real-time webcams), parks and gardens info, weather info (data from Spanish weather agency), traffic webcams, tourist offices info, museums and exhibition info, libraries info, number of interest info and sport facilities info.

Information related to the aforementioned five topics is shown to the user on a location aware manner. Information can be overlaid over the image captured by user's smartphone camera or presented over a Google Maps view. The application presents on one of these formats the POI which are closer to the user. Besides displaying information, it is also possible to request from the application to inform the user on the best route to reach them.

Santander's Participatory Sensing Service

Participatory Sensing service aims at exploiting the use of citizens' smartphones to make people to become active in contribution and generation data for the SmartSantander Platform. Citizens, Santander City Council and the local newspaper "El Diario Montañes" are connected into a common platform where they can report, share and be notified of events happening in the city. Users also utilize their mobile phones to send physical sensing information, e.g. GPS coordinates, compass, environmental data such as noise, temperature, etc., feeding this information into the same platform.

The Pace of the City application is the tool provided to citizens in order to generate the Pace of the City.

Available for both Android and iOS platforms since November 2012, it has reached more than 3500 downloads. The application allows the citizens to report the occurrence of events, which will subsequently be propagated to the SmartSantander platform and shared with the rest of the Pace of the City applications users. Furthermore, users with smart phones can receive the notifications on the occurred events via a smartphone application, by subscribing to the Pace of the City service. In this sense, all users interested in receiving the notifications have to register with the service, thereby their personal profile (including e.g. the preferred language) and selecting the information on which they are interested. A web interface has been also arranged to make this subscription.

Apart from the Pace of the City application, a web interface has been created both for Santander City Council and Local newspaper El Diario Montañes in order to allow them to report their own geo-positioned events.

Pace of the City Service is linked to their Citizens' Inbox service at Santander City Council, reporting those events that need to be solved by the municipality. Once they receive an event, they analyze and assign it to the corresponding team. In some cases, depending on the event type, some of them are automatically assigned (the most common ones).

As an example, a user is walking in the city center and finds a hole in the pavement; he can take a picture, write a text and finally share this incidence with the other users of the application. The Santander City Council will therefore be notified of the occurrence of the event and proceed accordingly by sending an employee to the location in order to fix this problem. Another example can be that a user reports on a road accident, all the other users (drivers) that are subscribed to this type of event will get notified and try to avoid this area. By being also connected to the Participatory Sensing service, the local newspaper "El Diario Montañes" also enriches this body of knowledge by sharing the daily news information with all the other users of the service, The newspaper has created an online information channel called "ElPulsodelaCiudad", which provides an interface to the citizens to access the Participatory Sensing events as well as public transport information, cultural agenda and sensors values retrieved from the SmartSantander IoT infrastructure from the same website.

Figure 6 shows the functionalities or services the user can interact with.

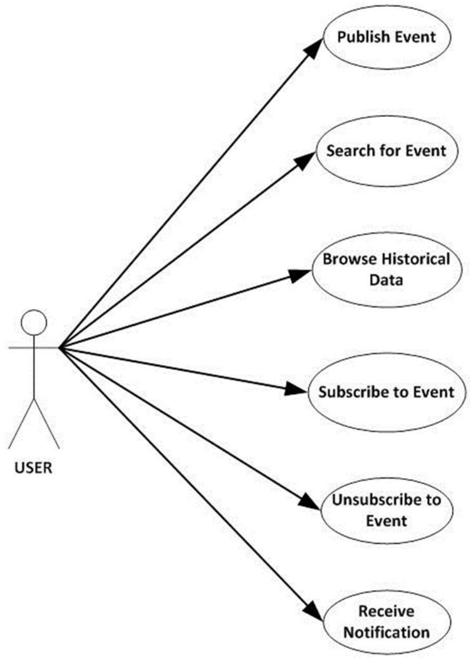

Figure 6. Participatory Sensing – Citizen Use Case diagram

For this scenario three software components were developed: 1) a mobile client application for the users; 2) a server that runs the service business logic and bridges the application with the SmartSantander platform which we call Pace Of The City Server; and 3) a server component that allows the mobile devices to register themselves to the SmartSantander platform called PSens Server.

The PulsodelaCiudad App (https://play.google.com/store/apps/details?id=com.eu.smartsantander.participatorysensing&hl=en, https://itunes.apple.com/es/app/pulsodelaciudad/id570422605?mt=8) enables the citizens to:

- Access to Historical information in a map or in a list (physical sensing information and previous events);
- Subscribe/Unsubscribe to specific types of events occurring in the city;
- Getting Notified of the occurrence of an event of a type the users are subscribed to;
- Search for Events filtering by date, type or location;
- Publish Events;

Figure 7 shows some screenshots from the application.

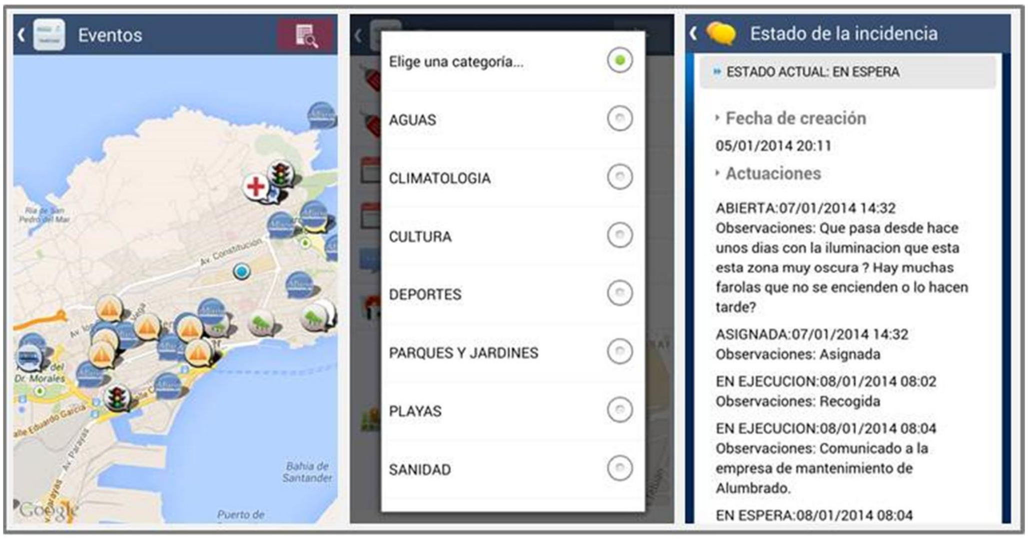

Figure 7. PulsodelaCiudad application screenshots

In order to tackle internally the incidences sent by the users through the Participatory Sensing scenario (for instance hole in the street events), the Santander City Council implemented two Web services developed using the Microsoft .NET 4.0fplatform which integrates the Participatory Sensing Scenario with the pre-existing system in the municipality to manage incidences (INCISYS). These web services collect the information from SmartSantander Participatory Sensing Scenario, then format, adapt and resend that data to the different departments responsible for resolving the incidence provided by the final user.

For this development all the standards proposed by the W3C were honored to ensure compatibility with any other platform interacting with the Santander Municipality's systems thus ensuring the interoperability with any other system. The standard adopted for this development has been "SOAP WS-I Basic Profile" (http://www.ws-i.org/Profiles/BasicProfile-1.1.html).

Conclusions

Smart cities are perfect ecosystems for cross-fertilizing ideas and actions in response to the crucial needs we all might be facing in the coming years to improve the quality of life and efficiency at the city level. Societal innovation paradigm can be leveraged by immersing urban society in a technologically advanced scenario thus fostering crowd-sourced creativity potential.

The deployment of the research-oriented IoT infrastructure described in this paper in the heart of a city, and the considerable investments required to create and amplify it to the necessary scale, motivates the exploitation of the facility beyond the experimental research community. The facility has therefore been conceived not only to act as a testbed for research with IoT technologies, but also for the development and evaluation of IoT enabled smart city services and applications targeting developers of commercial solutions.

Furthermore, it also caters for the actual end users by providing IoT enabled services to the city and their citizens. The involvement of end users adds another dimension to the evaluation capabilities of the platform by allowing not only the assessment of technical performance of IoT solutions, but also their societal implications and user acceptance (Schaffers et al., 2011b). This aspect is the one that promotes what the authors categorizes as societal innovation, being the engagement of communities towards the development of new concepts and solutions tackling societal needs (more effectively than alternatives) and creating new social relationships or collaborations.

From the different services already running on the Santander platform, this paper has presented the two services that best exemplifies our notion of societal innovation, namely the Augmented Reality Service and the Participatory Sensing Service.

SmartSantanderRA is a free Augmented Reality technology app that has been downloaded massively by more than 13500 people in less than one year, providing an interactive experience for both citizens and visitors when walking along the city. It provides a unified access to all city data sources, presents them in a context-sensitive and location aware manner to the end users using augmented reality technology. Additionally, the information implicitly generated by the user when using the application is processed by the system with the aim of acquiring knowledge about citizen preferences, mobility patterns and other statistics. The further analysis of this data will allow the creation of new services and experiments within the smart city context.

Thanks to the "Pace of the city" App developed, quantitative KPIs collected show evidence of improvements gained after the introduction of IoT, Specific examples we have are "City council time to resolve incidents" has decreased from 38 days (before IoT) to 5.71 (after), "Incidents reported to the municipality services", Before launching the Pace of the City service, 122 incidents were reported to the municipality services through the citizens' inbox during 10 months period in 2012 year. Since November 11th 2012 to the end of the year, 251 incidents were received by the municipality services. During the first six months of 2013 449 incidences have been reported. From a qualitative point of view it is important to highlight the interest from the population with more than 5000 people downloaded the application in the first 8 months.

Future work to be carried out will involve the deployment of new use cases, some of them oriented to strengthen the participation of the citizenship in the definition of new end-user services and their involvement in the validation of the proposed technological approaches. Furthermore, it is of utmost importance to add to the already existing smart city platform the tools allowing the assessment of the social engagement produced by the smart city services tested on top of Santander's IoT infrastructure.

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Acknowledgement

The work described in this paper has been carried out under the framework of the SmartSantnader project which has been partially funded by the European Commission under the contract number FP7-ICT-257992. The authors would also like to express their gratitude to the Spanish government for the funding in the following project: "Connectivity as a Service: Access for the Internet of the Future", COSAIF (TEC2012-38574-C02-01)."

About the Authors

Dr. Luis Sánchez received both the Telecommunications Engineering and Ph.D. degree by the University of Cantabria, Spain, in 2002 and 2009 respectively. He is assistant professor at the Dept. of Communications Engineering at the University of Cantabria. He is active on meshed networking on heterogeneous wireless scenarios and optimization of network performance through cognitive networking techniques.

Verónica Gutierrez received Telecommunications Engineering degree by the University of Cantabria, Spain, in 2000. She is currently a senior researcher at the University of Cantabria. She is active on different European projects framed under the smart city paradigm, such as SmartSantander, as well as others leveraging the Living Lab concept, sharing experiences within smart cities framework. Her research interests are on participatory sensing, augmented reality and middleware platforms for IoT-based smart city services development. She is currently working in the realization of her PhD.

Dr. Jose Antonio Galache received both the Telecommunications Engineering and Ph.D. degree by the University of Cantabria, Spain, in 2004 and 2013 respectively. He is currently active on different European projects framed under the smart city paradigm, such as SmartSantander, as well as others fostering collaboration between Europe and Japan, such as ClouT project, sharing experiences within smart cities framework. His research interests are on WSNs, wireless routing protocols and middleware platforms for managing heterogeneous networks, as well as M2M communications within the frame of a smart city.

Pablo Sotres works as research fellow in the Network Planning and Mobile Communications Laboratory, which belongs to the Communications Engineering department at the University of Cantabria, Spain. He received Telecommunications Engineering degree by the University of Cantabria in 2008. He is currently involved on different European projects framed under the smart city paradigm, such as SmartSantander; and related to inter-testbed federation, such as Fed4FIRE.

Juan Ramón Santana is a Telecommunication Engineer graduated in 2010 in the University of Cantabria, who is working as research fellow in the Network Planning and Mobile Communications Laboratory, a telecommunication research group from the same university. Prior to his current occupation, he did an internship in the University of Strathclyde (Glasgow) working on IoT solutions for six months. Some of the projects in which he is currently involved are SmartSantander and EAR-IT, European collaborative projects under the Seventh Framework Programme, related to the Smart City paradigm. He has multiples areas of interest including WSN (Wireless Sensor Networks), M2M communications and Mobile phone application research.

Professor Luis Muñoz received both the Telecommunications Engineering degree and Ph.D. from the Polytechnical University of Cataluña (UPC), Spain, in 1990 and 1995, respectively. He is head of the Network Planning and Mobile Communications Laboratory belonging to the Communications Engineering Department (DICOM) at the University of Cantabria, Spain. His research focuses on advanced data transmission techniques, heterogeneous wireless multihop networks and applied mathematical methods for telecommunications. He has participated in several National and European research projects belonging to the 4th, 5th, 6th and 7th Framework Program in which he is technical manager of SmartSantander. He has published over 150 journal and conference papers. He serves as editor of several journals. In parallel to this activity, he serves as consultant for the Spanish Government as well as for different companies in Europe and USA.

Urban Socio-technical Innovations with and by Citizens

Bastiaan Baccarne, Peter Mechant, Dimitri Schuurma & Lieven De Marez, iMinds-MICT-Ghent University, Belgium,
Pieter Colpaert, iMinds-MMLab-Ghent University, Belgium

Abstract

This article investigates bottom-up socio-technical innovations with and by citizen developers in an Urban living Lab, which is considered a platform for grassroots service creation in a city. In specific, the Living Lab framework is discussed as an instrumental platform within a Smart City, facilitating the governance of bottom-up innovation 'by' and 'with' citizens. The analysis is based on an in-depth case-study analysis on the use of Open Data and the 'hackathon' format within the Ghent Living Lab (Ghent, Belgium). The analytical framework focusses on the innovation ecosystem, urban transitions, user innovation, civic engagement, public and economic value creation and sustainability issues. Our findings explore the nature of the interactions and the outcomes of the projects. While hackathon events within an Urban Living Lab have already proven some of their potential, several opportunities remain. Especially the lack of involvement of private partners and a rather low focus on potential business models for the projects forecloses long-term sustainability and economic value creation. Central governance, focus on follow-up processes and a rigid innovation development framework are needed to overcome these challenges.

Keywords

Urban Living Labs, Smart Cities, Open Data, User-innovation, Socio-technical Innovations

Introduction

Increasing urbanization, grand societal challenges and rapid technological evolutions force cities to look for new ways to reinvent themselves. While urban new media is rapidly changing the social fabric of everyday life in the city (Atkinson, 1998), local governments often lack the capability and resources to react in a flexible way. In search for new ways to cope with this tension, transparency and close interaction with grassroots initiatives is increasingly put forward as one of the solutions to overcome this gap (ARUP, 2010). While the first generation of so-called Smart City projects and literature have a rather technological-deterministic point of view, this is changing slowly towards a more citizen-centric approach, focusing on smart citizens rather than on the Smart City as a high-tech solution to urban challenges (de Lange & de Waal, 2013). Smart cities thus embrace more user-centric points of view, such as an increased attention for user innovation, co-creation and collaboration with a wide variety of city stakeholders. Nevertheless, these interactions need to be governed and in some way be able to connect the traditional top-down approach with a grassroots or bottom-up approach.

This article investigates bottom-up socio-technical innovations with and by citizen developers in an Urban living Lab, which is considered a platform for open and systemic innovation and for grassroots service creation in a Smart City. In specific, we discuss the Living Lab framework as an instrumental platform which facilitates the governance of bottom-up innovation 'by' and 'with' citizens by analysing the use of Open Data and the 'hackathon' format within the Ghent Living Lab, an Urban Living Lab in the city of Ghent, Belgium, supervised by the local government. The analysis in this paper is being performed using an in-depth case-study analysis, ethnographic observations and adjuvant individual interviews with local civil servants involved in these activities. The analytical framework focusses on (1) the involved ecosystem, (2) urban transition, (3) user innovation, (4) civic engagement, (5) public and economic value creation and (6) sustainability issues. Through these dimensions an overall assessment is made of the potential of the Urban Living Lab framework to harness and govern citizen creation potential.

Literature review

Urban Living Labs

Worldwide, cities are transforming under the influence of rapid socio-technical innovations (Atkinson, 1998). Urban new media empower citizens through the democratization of knowledge and the availability of interactive ICT platforms (Castells, 2012; Tambini, 1999). At the same time, we are facing grand societal challenges such as global warming, congested traffic, ecological and economic challenges, aging populations, etc. Although these challenges transcend regions, nations and even continents, cities are often seen as the main driver for change and most relevant when it comes to tackle them (Grimm et al., 2008). With more and more people living in urbanized areas (Eurostat, 2012) cities are becoming central platforms for knowledge exchange and value generation. Against this backdrop, citizens are increasingly enabled to mold and tune their own urban environment and to collaborate with others to reach common goals (Foth, 2009). Nevertheless, city governments still struggle to cope with this unbounded citizen empowerment, since these grassroots initiatives take ownership of issues and solutions through decentralized networks (de Lange & de Waal, 2013) beyond governmental governance.

One of the frameworks that tries to overcome the tension between bottom-up initiatives and top-down governance is the Living Lab approach (Almirall, 2008). In EU programs such as i2010 and Europe 2020, the importance of Smart Cities is highlighted, and the Living Lab-approach is considered a best practice in this context (Paskaleva, 2011). By translating the Living Lab principles to an urban environment, (smart) cities are trying to foster user-innovation and tailor innovations to the needs of their citizens by stimulating collaborative development of innovations with multiple stakeholders. Juujärvi & Pesso (2013, p.22) define Urban Living Labs as "*a physical region in which different stakeholders form public-private-people partnerships of public agencies, firms, universities, and users collaborate to create, prototype, validate, and test new technologies, services, products, and systems in real-life contexts*". Such urban innovation ecosystems allow innovation development processes 'for', 'with' and 'by' citizens (Kaulio, 1998). In this paper, we will discuss this framework in relation to the 'hacker ethic' (Himanen, 2001) and the role of 'Open Data'.

Open Data

In order to support different forms of collaboration, certain data needs to be 'open'. This idea is reflected in the concept of 'Open Data' which derives from similar roots as 'Open Source' and 'Open Access'. Open Data refers to data that can be freely used, reused and redistributed by anyone, subject only, at most, to the requirement to attribute and share alike (OKFN, 2013). More concretely, Open Data is data that is published in an open format, is machine readable and is published under a license that allows for free reuse. Open Data is a part of a general trend towards open and transparent government, also coined Government 2.0 or Open Government. Scherpenisse et al. (2012) argue that this openness needs to be implemented on different levels, encompassing legal, technical, economic and political openness, thus providing a clear conceptual framework on openness and delineating Open Data further. Similarly, the Sunlight

Foundation as well as Bauer and Kaltenböck (2012) narrowed down the concept by formulating principles to be 'open'. Their basic assumption is that Open Data itself creates and generates more value than the selling of data sets. Based on a qualitative research approach Janssen et al. (2013) clustered the benefits of Open Data in (1) political and social (e.g. democratic accountability), (2) economic (e.g. stimulation of innovation), and (3) operational and technical benefits (e.g. validation and sustainability of data sets).

The 'hackathon' format

Hackathons are short events during which developers, programmers, designers and computer amateurs with various expertise-levels meet physically and work intensively to create software in a very short period of time (typically between a day and a week). Derived from 'hack' and 'marathon', these events tend to have a specific focus (e.g. type of programming language or datasets used) and are initiated and organized from a variety of (institutional) levels. Interestingly, the 'hack' in hackathon (also known as a hack day, hackfest or codefest) points to the original meaning of a hacker as someone who "programs enthusiastically" and believes it is an ethical duty to facilitate access to computers and computing resources (ZapicoLamela, Pargman, & Ebner, 2013). In that context, hackathons link up to the 'maker culture', a subculture representing a technology-based extension of the DIY (Do-It-Yourself) culture which promotes the idea that anyone is capable of performing a variety of tasks rather than relying on paid experts or specialists. Hackathons thus challenge the producer-consumer model of technology and embody an democratized technological practice, unifying playfulness, utility, and expressiveness while creating demand for new types of tools and literacies (Tanenbaum, Williams, Desjardins, & Tanenbaum, 2013).

The city as a 'platform'

Hackathons can be considered as a component of 'Open Government', in which (collaborative) technologies are injected into society to better solve collective problems on a city, regional or (inter)national level. Open Government addresses the government as an open platform that allows internal as well as external stakeholders to innovate. Thus, cities can be conceptualized as platforms, as architectures of participation. Tim O'Reilly, who considered Web 2.0 as a platform delivering software as a continually-updated service that gets better the more people use it (2005) broadened his approach to the government domain and formulated seven lessons that government can take from the success of these Web 2.0 platforms (O'Reilly, 2010). These lessons consider the city as a platform and include guidelines such as 'Open Standards Spark Innovation and Growth', 'Build a Simple System and Let It Evolve' or 'Data Mining Allows You to Harness Implicit Participation', often pointing to processes that support and mutually maximize collective intelligence and added value for each participant or that turn the analysis of recorded interaction data and collective behaviour - 'implicit' data that citizens produce (see also 'exhaust data' (McCracken, 2007), 'read wear' (Hill, Hollan, Wroblewski, & McCandless, 1992), 'drive-by data' (Kedrosky, 2005) or 'attention metadata' (Najjar, Wolpers, & Duval, 2006) - into added value. Government as platform is a 'service provider' enabling its 'local ecosystem'; actors in- and outside the public sector to innovate and evolve ideas through interaction.

While the abovementioned concepts of 'Smart Cities', 'Urban Living Labs', 'Open Data' and 'Hackathons' have gained a lot of attention (and funding) over the past years, only little research exists on the actual value creation and value creation potential of this approach. While both research and policy often promise disruptive solutions, improvement of life in the city and economic growth, there is a vast lack of evidence concerning the actual value that is being created and the processes that allow the exchange of value and knowledge. The next section briefly elaborates on the six research dimensions of our analysis.

The ecosystem

The collaborative nature of (Urban) Living Labs is related to the quadruple helix-model for innovation. Triple and quadruple helix-models deal with collaboration between universities, government(s), industry, and end-users (Arnkil, Järvensivu, Koski, & Piirainen, 2010). Co-operations like these have been claimed to facilitate exchange of ideas and technologies, with fewer barriers between academia, end-users, policy and industry (Etzkowitz, 2008). From this point of view, Living

Labs facilitate university-industry relationships, but also relationships between large companies and SME's, start-ups, entrepreneurs, and, most importantly, involve the citizens themselves, commonly referred to as public-private-people partnerships (4P's) (Westerlund & Leminen, 2011). Various Living Lab authors stress the importance of collaboration and knowledge support activities as cardinal to a successful Living Lab (Buitendag, van der Walt, Malebane, & de Jager, 2012; Feurstein, Hesmer, Hribernik, Thoben, & Schumacher, 2008). Such collaborative ecosystems promise to contribute to the facilitation of knowledge and information exchange among the ecosystem actors.

Urban Transition

Central to the Living Lab approach is to facilitate experiment in a real-life environment (Følstad, 2008). By setting up such experimental environments, the potential of ideas can be experienced by the ecosystem, stimulating change on a higher level. In this context, Nevens et al. (2013) put forward the concept of the Urban Transition Lab which is described as *"the locus within a city where (global) persistent problems are translated to the specific characteristics of the city […] It is a hybrid, flexible and transdisciplinary platform that provides space and time for learning, reflection and development of alternative solutions […]."* Such approach is related to some of the principles of transition management (Schliwa, 2013). Transition management focusses on the governance of problem solving and improvements in societal systems and *"[…] shapes processes of co-evolution, using visions, transition experiments and cycles of learning and adaptation"* (Kemp, Loorbach, & Rotmans, 2007).

User innovation

A third concept related to this domain, is the concept of user innovation. Approaching end-users as a potential source of innovation goes back to the Lead User-concept, conceived already back in the seventies by Eric von Hippel (see e.g. 1976, 1986). Lead Users face specific needs months or years before they will be general in the marketplace and they expect to benefit significantly by obtaining a solution to these needs (von Hippel, 2005). When a company succeeds in integrating Lead Users into their innovation processes, they can possibly overcome 'information stickiness' and solve their own functional fixedness. As was demonstrated within Lead User-research, user innovation is quite common in several product domains (e.g. extreme sports, see e.g. Lüthje, 2003). Inspired by von Hippels early work, academia and practitioners started to explore end-user involvement in innovation development processes. To provide an overview in these approaches, Kaulio (1998) distinguishes three degrees of user involvement in NPD processes: *'design for', 'design with'* and *'design by'* citizens/end-users.

Civic engagement

The concept of civic engagement is broad and multidimensional. While some authors restrict its application to political engagement, others argue that this interpretation is too narrow and stress the equal importance of non-political activities (Bennett, 2008). Raynes-Goldie & Walker (2008, p.162), for example, define civic engagement as *"any activity aimed at improving one's community"*. A more elaborate definition can be found in Ehrlich (2000, p.6), who describes civic engagement as *"[…] working to make a difference in the civic life of our communities and developing the combination of knowledge, skills, values and motivation to make that difference. It means promoting the quality of life in a community, through both political and non-political processes".* An important side note when assessing civic engagement is that citizens can only be engaged when they have the necessary knowledge, abilities, motivations, skills, chances and resources (Carpini, Cook, & Jacobs, 2004). Especially in an online or high-tech environment, access is not equal and often biased towards individuals with a higher education and a younger age (Van Dijk & Hacker, 2003). Related to civic engagement, especially in an urban environment, is the concept of community engagement, which connotes with involvement, commitment, passion, enthusiasm and focused effort. It requires social cohesion, civic skills, civic commitment or civic duty and civic action (Bobek, Zaff, Li, & Lerner, 2009, p.616). Community engagement goes further than participation and involvement because it also involves capturing people's attention and focusing their efforts (Aslin & Brown, 2004, p. 5).

Public and economic value creation

One of the central goals of an Urban Living Lab is to stimulate and facilitate the generation of value.

Within an urban environment this value can be twofold, since it can have both a public and an economic nature. The concept of *'public value'* refers to value that is generated through the creation and implementation of services and technologies that adequately harness opportunities within the city, tackle societal challenges and/or realize policy goals (Cosgrave & Tryfonas, 2012). It refers to, for example, reducing traffic jams, emancipating citizens, increasing neighbourhood cohesion or better governance. Because the generation of public value is the core of local governments (Baptista, 2005), Urban Living Labs differ fundamentally from traditional Living Labs and Open Innovation ecosystems which are often rooted in commercial contexts. Public value can be evaluated in terms of reach of the project (who and how many are going to use offered services), of impact (will it create benefits for all possible users), and of cost and value for money (how much will it cost and will it provide sufficient value in return) (Walravens, 2012). On the other hand, value can also address economic growth and innovation (e.g. less transaction costs in accessing/using information by providing Open Datasets). Such *'economic value'* covers economic metrics such as the annual economic growth of cities and companies within the city, a decrease in unemployment, the extent to which new businesses (start-ups) are being generated and able to survive, a reduction of bankruptcies, an increased competitive advantage, attracting existing businesses to the city, etc.

Sustainability

Urban Living Labs contribute the goals of Smart Cities, which strive to become 'greener' (with smart energy, smart environments and smart mobility), and more 'liveable' (with smart health, smart education and smart living/working), increasing the overall quality of life and place for city inhabitants (Caragliu, Del Bo, & Nijkamp, 2009; Dolente, Galea, & Leporelli, 2010). In their work, Caragliu et al. put forward social and environmental sustainability as a major strategic component of Smart Cities. The collaborative ecosystem aims at an efficient allocation and (re)combination of resources which are present within the urban environment when developing innovations. On a generic level, sustainability can be defined as *"to meet the needs of the present without compromising the ability for the future generation to meet their needs"* (World Commission on Environment and Development, 1987). The sustainability concept has a broad application range and can therefore be measured through various sets of criteria ranging from simple to complex. In the context of this paper, Hart (1995) suggests the following criteria: the process, service or product needs to (1) be multi-dimensional, linking two or more categories, (2) be forward looking (3) emphasis on local wealth, local resources and local needs (4) emphasis on appropriate levels and types of consumption (5) use measures that are easy to understand and display changes (6) produce reliable, accurate, frequently reported data that is readily available (7) reflect local sustainability that enhances global sustainability. On top of that, sustainability is also related to reuse of generated resources (e.g. knowledge, data and infrastructure). Reuse is critical, as it allows working on existing artefacts instead of starting from scratch, thereby enabling the development and deployment of software and services with greater ease. Consequently, time and human effort required to develop software product and pilots can also be effectively reduced. In addition to this, iterative reuse can also have a relevant, verifiable impact on product productivity and quality, as reusing existing artefacts can iteratively improve the quality of the product or service.

Methodology

The analysis in this paper is being performed using an in-depth case-study analysis, ethnographic observations and adjuvant individual interviews with local civil servants involved in these activities. Because of the exploratory nature of this research, a multidimensional case-study analysis is the most suitable approach (Yin, 1984). Case study research excels at bringing an understanding of a complex issue and can extend knowledge or add strength to what is already known through previous research. On top of that, case studies are most suited for processes which are poorly understood and lack a (solid) theoretical foundation (Eisenhardt, 1989), allow to analyse the process open-ended and on multiple levels (Yin, 1984) and gain deeper qualitative insights. Yin defines the case study research method as an empirical inquiry that investigates a contemporary phenomenon within its real-life context; when the boundaries between phenomenon and context are not clearly evident; and in which multiple sources of evidence are used.

Given the complexity of the studied phenomenon and the multiple levels of analysis, a case-study design seems most appropriate.

For the case study analysis, we analyse the use of open data and the 'hackathon' format within the Ghent Living Lab, an Urban Living Lab in the city of Ghent, Belgium, supervised by the local government. Driven by the local translation of the Europe 2020 agenda, this Living Lab was founded by the city government as a platform to connect local stakeholders and enable socio-technical innovation to be co-developed and tested within an urban environment. More specific, we study a central case within this Living Lab, being a yearly bottom-up citizen developer project – Apps for Ghent – aimed at innovative urban service creation based on open (governmental) data sources. Besides the in-depth case-study analysis, ethnographic observations and three adjuvant individual interviews with local civil servants enriched the insights presented in this paper. The analytical framework focusses on (1) the involved ecosystem, (2) urban transition (3) user-innovation, (4) civic engagement, (5) public and economic value creation and (6) sustainability issues. Through these dimensions an overall assessment is made of the potential of the Urban Living Lab framework to harness and govern citizen creation potential.

Ghent Living Lab

Ghent Living Lab (GLL) is an Urban Living Lab, governed by the city council. Key partners include the local government and its service partners, iMinds (Flemish organization supporting innovation in media and ICT), all major colleges and universities in the city, local (developer) networks and community organizations. GLL acts as a facilitator between the different parts of the collaborative network that has been established between the research community, businesses, the public sector, citizens and the wider community. Its primary focus is on Smart Cities and the development of Future Internet related services to support the further development of Smart Cities. GLL serves as a learning platform and as a test and development environment. It is a tool to work with researchers, entrepreneurs, citizens, digital creative forces and the city council on joint trajectories in function of product development, research, service delivery and policy strategy. GLL is also an effective member of the European Network of Living Labs.

Apps for Ghent

Apps for Ghent is a yearly hackathon event in the city of Ghent as a part of the activities of the Ghent Living Lab, organized by the city council, Open Knowledge Foundation Belgium, iMinds-MultiMediaLab and Ghent Web Valley. The goal is to stimulate both citizens and professionals in the city to work with the open governmental datasets, provided by the city council. The central philosophy is that governmental data is gathered with public resources and should therefore be open to the public. On top of that, it is believed that application-development can be more efficient and user-centric when this is outsourced by the local government. Three editions of this event have taken place (2011, 2012 and 2013) at the moment of this analysis (table 1). The format consists of a hackathon, during which participants are challenged by the city council and a plenary pitch of the developed prototypes. Each edition had several financial-material prices that could be won by the best teams.

Table 1. Overview of the Apps for Ghent hackathons

	2011	2012	2013
Professional teams	4	6	8
Student teams	1	2	5
Other teams	5	2	2
Total teams participating	10	10	15

Results

This section reflects on the previously theoretically discussed research dimensions in relation to the Apps for Ghent case. For this analysis we frame the hackathons as innovation development projects within the Ghent Living Lab, which is considered an Urban Living Lab contributing to the local Smart City strategy.

Ecosystem

One of the foundations of GLL is the establishment of an ecosystem in which all city stakeholders can collaborate, which should allow optimal valorisation of intelligence and skills that are present in the city. Such collective was set up through a formal agreement. The Apps for Ghent event strengthens ties between the ecosystem partners and showcases the possibilities of collaborations. It lowers the barriers for future collaboration, thus enhancing the collaborative capacity of the innovation ecosystem and putting quadruple helix models in practice. The format is successful in creating a fertile ground for innovation, albeit on a limited scale. The Apps for Ghent format mainly involves the city government, IT students, IT start-ups and research partners. Since this is only a section of the innovation ecosystem, including more city stakeholders could enhance knowledge exchange. Current knowledge exchange includes the exchange of governmental data, private data (e.g. power company and waste collection), knowledge between students and professional developers and research knowledge (Open Data management system). Especially the aggregation and (re)combination of different data resources in the city is considered very valuable.

Through this approach, the local government aims at increasing its capacity to respond more adequately to opportunities. Not in a traditional top-down way, but by stimulating, supporting and connecting grassroots initiatives, meanwhile allowing a more 'lean and mean' interaction with the local government. Innovation ecosystems exist in a city, even without involvement of a government. An Urban Living Lab allows for cities to play a role in these ecosystems. This role should, however, be carefully considered, since a local government cannot control these ecosystems, but should instead fulfil a facilitating and connecting role.

Urban Transition

Apps for Ghent is organized as an experiment, instigated by local civil servants (as an internal bottom-up initiative). For the local government, these experiments were the first step towards an Open Government policy, embedded in a long-term strategy. The current and future regulatory frameworks are considered impossible without these experiments. Hackathons can therefore be considered a medium which allow leveraging policy innovation. The tangible outcomes of the experiments are indeed showcases, but they contribute to a higher, more sustainable, level of change. Hackathons and Urban Living Labs should in the first place be considered spaces for experiment and learning. But meanwhile, *'it becomes some sort of alibi for much more than Open Data'*. For experiments at the micro level, the involvement of the local government is rather limited. At the meso level however, the local government increasingly acts as a facilitator, trying to detect and connect micro level experiments and providing supporting (technological) infrastructure such as a central data portal. At the macro level, finally, urban transition should in the long run evolve towards an Open Government, focusing on transparency, co-creation and participation and even towards an Open City System in which all city stakeholders follow this policy, thus optimally enabling knowledge exchange and collaborative value creation.

The format of a hackathon and an Urban Living Lab also allow experiencing change. This is important for civil servants, politicians and other city stakeholders. Since temporary allowing experiment reduces uncertainty (e.g. fear of unwanted data usage) and convinces stakeholders of the benefits. It opens eyes and allows assessing an innovative idea more clearly. Concerning the potential of this approach to meet the before mentioned grand societal challenges one of the interviewees pointed out that …

> *"Tackling long-term problems is hard and can only be achieved by a long sequence of short-term experiments. The sustainability is not to be found at the level of the products and services that come out of these experiments; it is that*

what is hidden behind these artefacts that will solve societal problems in the long run." [translated interview transcript]

User innovation

Mobile applications are not considered sustainable investments by the local government. Therefore the development of such innovations it outsourced to citizen developers, students and private actors in the city. The city positions itself as an enabler in this domain by providing data, a central platform and by facilitating collaboration. On a higher level, this frames within a broader reconfiguration of the role of the government. Citizens used to expect everything of the government, but this is no longer tolerated. In practice, this means that citizens are increasingly empowered to take initiative themselves. This, however, does not mean that these initiatives substitute governmental activities but it rather supplements them. The local government tries not to control these bottom-up innovations, but to develop a canvas for creation, learning and experiment through the facilitation of collaboration and the provision of governmental data.

When assessing the nature of user involvement in the innovation development processes from the perspective of the local government, three levels of analysis should be taken into account. The innovation can occur at the policy level, at the level of the product or service and at the intermediary level. However, all three dimensions are coupled and should always resonate in order to each be successful. On the level of policy innovation, hackathons are considered as valuable input for the optimization of governmental processes, products and policy. This reveals a clear 'design for' strategy; since civil servants and politicians will translate this knowledge and develop the innovations themselves. It is considered a way to capture 'sticky knowledge' trough the act of creation (in line with design thinking literature). It allows talking about city improvements in another language. On the level of products and services, on the other hand, user involvement can be defined as 'design by' citizens, since the developers are completely free in the act of creation, which also means that this process is hard to govern. Hackathon participants translate the available data to their own context and needs. Finally, at the intermediary level, allowing people to play with governmental data forces the local government to clean these data and develop standards. Intense interaction with developers allows co-creating tools which optimize information exchange between the government and the developers ('design with').

Civic engagement

Civic engagement used to be very much institutionalized. However, civil society is now deinstitutionalizing, which creates space for a new form of civic engagement. This civic engagement is rather ad hoc and based on a shared set of values and motivations (Rheingold, 2002). In this case, hackathon-engagement is mainly driven by (1) motivation to improve their city, (2) enhancing the individual portfolio and network, (3) being part of a 'hacker' community (4) show-off and benchmark skills (friendly competition) and (5) the fun of coding. These projects are 'tech-driven', which only attracts participants with a high level of technological knowledge and skills. However, this niche can be stimulated to use their (unique and valuable) skills for the improvement of the community, to make a difference and increase the quality of life in the city.

> *"... they start to consider their skills as a way to co-mold the city, like an artisan [...] it can be considered as a new form of digital citizenship."* [translated interview transcript]

However, high barriers exist to participate. Participants need the right knowledge, skills and motivation. When it comes to coding and hackathons, technical barriers are very high for the average citizen. This makes it hard to reach 'mainstream' citizens. Attempts to include them as 'thinkers' in the hackathon teams have not been successful due to the niche perception of the hackathon format. What is interesting, however, is that several hackathon creations aim at enabling and facilitating citizen engagement (e.g. facilitating interaction between the government and citizens). This way, a developer niche creates an instrument for a broader civic engagement.

Public & economic value creation

When looking at the level of products and services, none of the hackathon outcomes has been economically successful. This might be explained by the limited scale in which urban mobile applications can be deployed and the lack of attention for possible business models which causes the artefacts to create value, but not to capture it. Instead, the economic value of hackathons in an Urban Living Lab has a derivative, second order nature. What is perceived as the true value is the enabling network, the increased closeness of ecosystem actors. This creates a fertile ground for collaborations, but also for start-ups and spin-offs. Furthermore, this format contributes to the branding of the city as an innovative environment, which (successfully) attracts new economic activity. It is part of the acquisition strategy of the city government and is in line with the morphology of the city (with a prominent presence of students and universities, and a vibrant scene of digital creatives). This approach has also been successful in keeping talent in the Ghent area (a lot of the student-hackers are now employed in local IT firms) and stimulating local start-ups. However, this dimension is hard to measure and hard to link directly to the hackathon and/or Urban Living Lab.

Besides the potential for urban transition and the close interaction with civic engagement, as discussed above, public value is also generated through an increased social cohesion. Different hackathon outcomes focus on (re)connecting city inhabitants through urban new media (e.g. social games and applications to meet likeminded citizens). However, a lot of potential is still untapped since actual implementation of the hackathon outcomes is rather exceptional. This can be explained by a lack of attention for value capture and follow-up processes. Innovation ecosystems such as an Urban Living Lab increase the ability of a local government to monitor different initiatives in the city. If a government stumbles upon a solution that contributes substantially to a significant problem, public resources should be invested to leverage this initiative and generate public value with an increased sustainability.

Sustainability

As discussed before, the single act of creation does create value as such, but fails to capture the value, which is needed for further development and long-term maintenance incentives. The process of translating conceptual initiatives to market ready products is still lacking. This is mainly because this is not the primary goal of the hackathon. Sustainability on a product and service level could be leveraged by implementing these artefacts in a NPD process, following an Urban Living Lab approach. In this context, the nature of the user involvement would shift from 'design by' to 'design with' citizens. The combination of a hackathon and an Urban Living Lab can be considered as an untapped potential for bottom-up innovation. Many hackathons exist, but the embeddedness within an Urban Living Lab is rather unique. This holds some interesting opportunities to overcome digital divide and sustainability issues. Some follow-up tracks exist for the hackathon outcomes (allowing students to continue their work during the summer break), but a lot of barriers still hamper successful outcomes. This is closely related to the limited availability of public resources. A hackathon requires very little resources, as opposed to intensive iterative long-term multi-stakeholder follow-up processes. However, the single moment of creation contributes to other dimensions, as discussed in the context of urban transition it contributes to the evolution towards an Open Government, including a collaborative innovation ecosystem, which can be considered more sustainable. In the light of Hart's (1995) sustainability dimensions, an Urban Living Lab is able to connect different domains and stakeholders, is forward looking (long-term strategy), emphasises local value creation, answers local needs and contributes to solving global issues starting from a local initiatives. However, (hard, objective) measurements are needed to reflect and support these assumptions.

From a reuse point of view, Urban Living Labs have in interesting (untapped) potential concerning the reuse of different networks (people and organizations), (technical) infrastructures, (governmental) data, code and knowledge. The deployed innovation ecosystem, with the local government in a central enabling position, could integrate such resources in a single framework, increasing access for secondary use. This would greatly increase the connective capacity (Lichtenthaler & Lichtenthaler, 2009) of the innovation ecosystem. However, it is, once again, important for the governmental actor to choose its role in this ecosystem wisely. Such central governance cannot be about ownership, but should be about access.

> *"An Urban Living Lab can play an important role to interconnect all these resources. Not to*

use it for themselves, but to make them accessible, to make sure that the soil for innovation is as fertile as possible. It sort of goes back to the old concept of the government as a director." [translated interview transcript]

Discussion and conclusion

In this article, an Urban Living Lab is considered a collaborative ecosystem allowing for the co-creation of sustainable, future proof innovations that improve life in the city and boost the economy, in which Open Data plays an enabling role. More specifically, we discussed the dynamics of a hackathon, embedded in an Urban Living Lab. Our findings show the multilevelness of these projects and highlight the strengths, weaknesses and opportunities. The Urban Living Lab framework is a useful framework to combine top-down governance with bottom-up initiatives in the city. However, some challenges remain. Whereas experimental activities within an Urban Living Lab activate and reinforce the quadruple helix ecosystem, facilitating collaboration and enabling interaction with the city government, it is still hard to harness the creation potential within a city in a sustainable way. Nevertheless, sustainable enabling value is being created on higher levels (intermediary infrastructures, increased transparency, favourable policy, lowered barrier for knowledge exchange and collaboration). Urban Living Labs facilitate urban transitions through an accumulation of experiments, which allow experiencing change, causing transitions on the meso (facilitating infrastructures) and the macro (policy and society) level in the long run. From an innovation development perspective, hackathon projects involve users in three ways. At the level of the products and services, a 'design by' citizens approach is followed, at the level of policy innovation, local governments 'design for' citizens and at the level of the intermediary infrastructure a 'design with' citizens approach is followed. This approach raises barriers for participation but also generates useful knowledge for local governments.

Furthermore, Urban Living Labs should act as 'reuse enablers' through central governance of 'fertilizing' resources. Within the Urban Living Lab as an innovation ecosystem - and in line with Janssen et al. (2013) - Open Data provides social and political benefits (e.g. transparency and accountability), economic benefits (e.g. fostering innovation and attracting economic activity) and operational benefits (improving data quality, standardisation, data portal and cohesion). In the evolution towards an Open Government, the Urban Living Lab should also govern and disclose networks (interpersonal and inter-organizational), infrastructure (e.g. sensor networks), artefacts (e.g. code and algorithms) and knowledge (e.g. research data) to increase connective capacity (Lichtenthaler & Lichtenthaler, 2009) in the city thus enhancing the sustainability of the generated value and knowledge.

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Acknowledgement

The research leading to these results has received funding from the Department of Economy, Science and Innovation (EWI Department) of the Flemish Government. We would like to acknowledge Jelle Monstrey, Bart Rousseau and Karl-Filip Coenegrachts of the City of Ghent.

About the Authors

Bastiaan Baccarne is a research and teaching assistant at iMinds-MICT, a research group within the communications department of Ghent University, where he works on the topic of user-centric innovation development in the context of (new) media and ICT. Bastiaan is also a PhD student working on citizen empowerment through the co-development of socio-technical innovations in an urban environment. Being part of iMinds-iLab.o, Bastiaan works as a user researcher for several SME and start-up projects, with an overall academic focus on the possibilities and limitations of user-centric innovation development ecosystems.

Peter Mechant (PhD Communication Sciences) works at the research group for Media and ICT at Ghent University and iMinds. Peter has a keen interest in 'Big' (Social Media) Data and the additional value it can provide to social research, investigating these opportunities from a theoretical as well as a practical perspective. Peter has published in journals such as Observatorio, International Journal of Web-based Communities, IJICST, Contemporary Social Science and European Journal of Communication Research and coauthored papers in journals such as New Media and Society, Journal of Computer-mediated Communication and Cyberpsychology, Behaviour and Social Networking and Communication & Strategies.

Dimitri Schuurman is a Senior Researcher at the iMinds Media & ICT (MICT) research group and is responsible for the methodology of living lab projects facilitated by iMinds iLab.o. His involvement in living labs started in 2010 with the Mediatuin and LeYLab living labs. To date, he has managed over 30 concrete living lab projects that deal with new media and innovative use of ICT. He is currently finishing his PhD on living labs at Ghent University in Belgium.

Pieter Colpaert holds an engineering degree in informatics from College Ghent, Belgium. Before his position as a researcher in Linked Open Data at MultiMediaLab - Ghent University, he started his own company which visualizes Open Data on digital information screens (FlatTurtle) and founded the Belgian chapter of the Open Knowledge Foundation. In order to lower the barrier for data owners to publish data, Pieter started The DataTank as part of his master's thesis in 2010, and continued working on it until today.

With a master's degrees in communication sciences (1999) and marketing (2000), and a PhD on the 'Diffusion of ICT-innovations: more accurate user insight for better introduction strategies', **Lieven De Marez'** main expertise is on the development of 'segmentation forecast' tools for prior-to-launch adoption potential forecasts for new media and ICT-innovations. As the head of the iMinds research group for Media & ICT (iMinds – MICT – UGent, Digital Society Department) and manager of iMinds iLab.o's media living lab activities he continuously seeks to explore new methodologies to understand emerging media use patterns, the impact of new media & ICT, and make media innovation more user-centric. At the department of communication studies he founded and coordinates the Master 'new media & society'.

Living Lab's One-Stop-Shop Services in the Development of Remote Services in Public Sector

Lotta Haukipuro, Satu Väinämö & Leena Arhippainen, University of Oulu, Center for Internet Excellence, OULLabs, Finland

Abstract

This paper presents an example of a Living Lab, OULLabs' one-stop-shop service, the remote-enabled public service development project. The project, conducted in cooperation with the City of Oulu in 2013, brought citizens, employees and authorities together to identify development needs for remote-enabled public services in three different locations in the City of Oulu, and in three other municipalities nearby. OULLabs' one-stop-shop services were used to solve the challenges in the development of remote-enabled public services. The services provided by OULLabs during this development project were service design, user studies, two separate online discussions in the PATIO forum for citizens as well as employees and authorities, and a survey using public interactive displays (UBI hotspots). One hundred and eighty users (citizens, employees and authorities) in the City of Oulu and three municipalities (Ii, Muhos and Utajärvi) were involved in the activities of the development project. This achieved the result of a positive experience of testing the one-stop shop service. Furthermore, use of multiple methods ensured reliable and comprehensive results.

Keywords

Living Lab, one-stop-shop, user involvement, user-driven service development, user experience

Introduction

This paper presents an example of OULLabs' one-stop-shop services, the remote-enabled public service development project. Remote-enabled public services (hereafter remote services) as used in this study mean public services (e.g. unemployment registration) carried out through video meeting. These remote services replace services that are traditionally provided face-to-face. The new service is easier to reach, especially for people living far away from services. In the City of Oulu, the farthest residents live as far as 80 kilometres from the city centre and public services. Thus, there has been an enormous need for remote services. The development project, conducted in cooperation with the City of Oulu in 2013, brought citizens, employees and authorities together to identify development needs for remote services in three different locations in the City of Oulu and in three municipalities nearby.

Various challenges have been identified in the development of remote services in the City of Oulu.

One of those challenges has been the different needs of the players involved: service providers (authorities and municipalities) and employees. Another challenge has been the implementation of the physical remote service point in the existing premises of a municipality and merging the new service into existing processes. As the remote service is new to the City of Oulu, it has brought challenges to all parties involved: employees, authorities and users. Furthermore, the municipalities do not have the resources, skills or competence to involve users in the development process. However, the City of Oulu considered user involvement to be an important element in the development of the remote service. On the basis of their experience of previous cooperation projects regarding citizen involvement and the use of the Living Lab approach in city processes, OULLabs' (Oulu Urban Living Labs) one-stop-shop services were seen as a suitable way in which to solve the challenges in the development of remote services.

OULLabs, located in Oulu, Finland, provides companies, public sector and research institutes with a variety of services including users, test environments and specialist services. OULLabs provides all services in one place on a 'one-stop-shop principle' for the ideation, testing and development of products, services and applications. The services provided by OULLabs during this development project were user studies, service design, two separate online discussions on the PATIO forum (www.patiolla.fi) for citizens and employees and authorities, a survey using public interactive displays or UBI hotspots (www.ubioulu.fi), and project coordination for identifying the development needs of remote services.

Theoretical Framework

A Living Lab can be defined as a network that integrates both user-centred research and open innovation (Leminen et al., 2012). Living Labs are driven by two ideas: involving users as equal co-creators with the other participants, and experiments in real-world settings (Almirall et al., 2012). Living Labs are seen as separate from other innovation approaches because of two dimensions: their high degree of realism and their high degree of user involvement (Schuurman & De Marez, 2012). Compared to, for instance, field trials or user testing, a Living Lab involves users in all stages of Research & Development (R&D) and the product development lifecycle (Ballon et al., 2005).

The aim of service design is to create services that are useful, usable and desirable from the user's perspective, and efficient, effective and different from the provider's perspective (Moritz, 2005; Mager & Sung, 2011). Service design concentrates on the full customer journey, taking into account experiences before and after the service encounters. In particular, co-creation has been seen as an important driving force, which means involving users, employees and other stakeholders in the design process. The aim is to integrate the service from the viewpoints of those parties that are at the heart of the service experience (Mager & Sung, 2011).

The customer journey depicts how the customer perceives and experiences the service along a period of time, taking into account the phases before and after actual interaction with the service. The first step in creating a customer journey is to identify and decide its starting and stopping points (Mager 2009). It is critical to understand the meaning and importance of the user experience during the customer journey. As ISO standard 9241-210 (2010) defines user experience (UX) as, "a person's perceptions and responses that results from the use and/or anticipated use of a product, system or service", it is important to study user experiences before, during and after the use of a service or product (Vermeeren et al., 2010). When a customer interacts with a service provider (e.g. city, company, etc.) they have an experience, and the context of the use to a large extent contributes to that experience, including people, technologies and interfaces encountered throughout the customer journey. Therefore, it is important to take a multidisciplinary approach in order to achieve a rich, comprehensive and integrated view of the service experience by the customer (Teixeira, 2010).

Empirical studies

In this study, multiple user involvement methods were used to ensure a comprehensive view of the service. One hundred and eighty users (citizens, employees and authorities) and four municipalities including the City of Oulu were involved in the activities of the development project. Four different methods were used in this study: user experience studies, service design, in-depth online discussions and a survey on large public interactive displays.

Service Design

Service design as a method enables the identification of the key elements of a service as well as links between the elements. Moreover, improvement needs for the service can be identified in order to create the service desired by its users.

In this study, service design was carried out by creating customer journey and improvement recommendations for remote services at six different service points. Before the creation of the customer journey, 14 employees were interviewed and the existing customer journey was observed in all locations. Observation was organised so that the UX researcher acted as a customer and walked through the customer journey with the employee of the service point in as authentic a setting as possible. During the journey, the service designer observed and photographed the session. The UX researcher and the service designer analysed the collected materials. Based on the results, a common customer journey (Figure 1) and improvement recommendations for each service point were created.

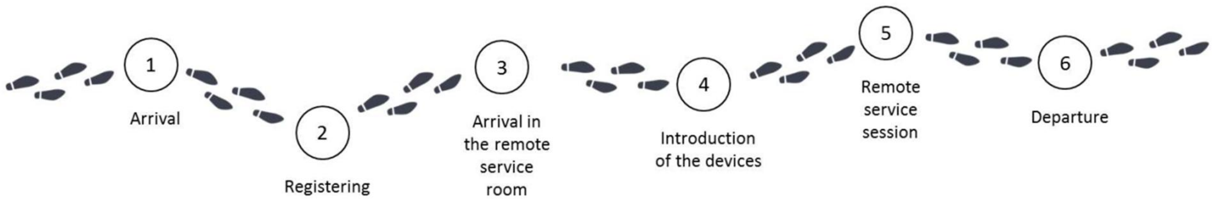

Figure 1. The common customer journey.

All six service points varied by the use and suitability of the premises, the video meeting equipment and the number of assisting personnel at the service point. The two service points in Kiiminki (Figure 2) and Ylikiiminki (Figure 3) are presented in the figures below. These two locations are used for different purposes: the Kiiminki service point is located in a public bureau (Figure 2) and Ylikiiminki is mainly used as a free-time meeting point but also acts as a municipal service point for residents (Figure 3). Phases 1, 2 and 5 of the customer journey (Figure 1) can be seen in both figures (Figures 2 and 3).

Figure 2. The Kiiminki service point.

Figure 3. The Ylikiiminki service point.

User Experience Research

User experience studies were conducted in four different locations (Ii, Kiiminki, Yli-Ii and Ylikiiminki) with 12 test users to gather more specific information about usability and the user experience of remote service, and to find out whether the users would use the service in the future. The participants' age varied from 35 to 70 years, and 58% of them were female. The participants were interviewed before and after the use of the remote service and observed during their use. All sessions were video recorded. The test procedure followed pre-defined scenarios relating to the provided services (e.g. local register offices and building control). Each participant had a unique and as authentic as possible use case. The technology used in the test sessions varied according to the remote service points. However, in each session a video connection, a monitor and a microphone were used (Figure 4A). In addition, some participants used a document camera to show certain documents (e.g., town plan, receipts) to the service provider (Figure 4B).

Figure 4 A) The participant is discussing with the service provider using the video connection.
B) Another participant is showing a city plan by using a document camera and asking questions of the service provider (in this case the city's building control).

After they had used the remote service, the participants' experiences were collected by using the adjective selection method and the 5-point Likert Scale questionnaire (19 statements). The first version of the adjective selection method is presented by Sunnari et al. (2012) and the idea of using adjectives came from the literature (Benedek & Miner, 2002; Barnum & Palmer, 2010). In this study, the participants were asked to express their experiences by selecting three (3) out of 16 adjectives, which depict their experiences relating to the use of the service. In addition, participants were asked to write down one word or sentence about how they had experienced the service. Afterwards, the researcher discussed the experiences with the participant.

PATIO online discussions and UBI survey

The user involvement online tool PATIO (www.patiolla.fi) offers companies, organisations and research groups an easy way in which to involve users in the development of products and services. PATIO enables the recruitment of users according to particular criteria and the collection of user experiences through online discussions, surveys and diaries, among other methods, in a flexible manner. PATIO users can participate in various development activities anytime and anywhere, and share their ideas, opinions and experiences, as well as give feedback. In addition, by participating, users also acquire knowledge and new information, for instance, about new products or local public services. PATIO has a reward points system to increase users' willingness and motivation to participate. Furthermore, users receive feedback on how they have influenced product or service development. In this study, PATIO was used for collecting the opinions and ideas of citizens, employees and authorities on remote services. Two separate online discussions were organised on the forum for two weeks: one for citizens and another for employees and authorities working with remote services. Forum moderator services were also provided by OULLabs. The first online discussion was open for everyone, for ideation and sharing opinions on remote services for public. Thirty participants were involved in the online discussion. In the second online discussion, targeted at employees and authorities working with remote services, 10 employees and authorities shared their experiences and ideas regarding remote services.

The Open UBI Oulu (http://www.ubioulu.fi/en/node/91) is a unique public city laboratory for studying human-city interactions in the real environment. Citizens use the infrastructure and services in authentic urban settings on their own. UBI hotspots, large interactive touch screen displays placed in 15 public locations around the City of Oulu, were used in this study. A public interactive quick multiple choice survey was published on UBI hotspots for two weeks in order to collect opinions on remote services from citizens who were walking by. Additionally, as UBI hotspots are commonly better known as an advertisement channel, visibility for the new service was achieved by placing an advertisement for remote services on all of the UBI hotspots around the city. One hundred and twenty-two citizens responded to the UBI survey.

Results and conclusions

Multilateral benefits were achieved as a result of the development project. The municipalities gathered recommendations and improvement ideas for further development of remote services, as well as the knowledge that there is a need for remote services. The authorities were able to pilot their remote service in an authentic setting with real users. Furthermore, they gathered experience and were able to improve the service on the basis of feedback. From the perspective of Living Lab, positive experience of providing one-stop shop service was achieved.

The service design and user experience research gave valuable information for the customer on how to develop remote services while taking into account users' perspectives. As a result, a customer journey was created in order to provide a user-friendly remote service in different locations. According to the user experience studies, participants had very positive experiences about the service and were willing to use remote services in the future as well. The online forum PATIO was perceived to be useful in increasing discussion and the commitment of employees working with remote services. Employees and authorities providing remote services were able to meet each other virtually and change their opinions as well as ask for advice in the private discussion. In another discussion aimed at citizens, residents of Oulu were able to share their opinions and needs regarding remote services. In addition to the qualitative data collected during the online discussions, quantitative data was collected through the survey using UBI hotspots. The use of multiple methods ensured the reliability of the results, as the same types of questions were placed in several channels for the citizens to view.

From the Living Lab point of view, valuable experience of successful one-stop-shop service deployment, including the use of ICT-based user involvement tools and specialist services, was achieved. We will utilise and evaluate this one-stop-shop approach in future projects as well. The results of this project may act as a reference when forming processes to involve citizens in development activities. By involving citizens in development activities, future services can better meet the needs of their users.

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Acknowledgement

We would like to thank the City of Oulu, the EPPI remote service development project, and the authorities, employees and participants involved in the studies.

About the Authors

Lotta Haukipuro, University of Oulu, Center for Internet Excellence, OULLabs, Finland

Satu Väinämö, University of Oulu, Center for Internet Excellence, OULLabs, Finland

Leena Arhippainen, University of Oulu, Center for Internet Excellence, OULLabs, Finland

A Multi-Discipline Rapid Innovation Method

Timo Kaski, Ari Alamäki & Anu Moisio, HAAGA-HELIA University of Applied Sciences, Finland

Abstract

The focus of innovation activities has moved from closed top-down activities towards open innovation type of initiatives. But how can organizations implement open innovation projects effectively? How to speed up the timespan required from idea creation to concept testing? Generally, innovation initiatives tend to turn out being just idea generation machines or open-ended experiments with unclear deliverables.

This paper introduces a single case study on a novel method to make participatory open innovation happen faster and more effectively. The method comprises the typical participatory open innovation approach with the concept of rapid innovation and coaching. This way it compresses the key phases of the innovation process into two working days.

The InnoCamp model was tested at Vierumäki Sport Institute for two days with sport companies. The companies were looking for new ideas or solutions for their existing sport services and products. The functionality of the test project was evaluated through qualitative research data.

The research data suggests that the Two-day InnoCamp method can produce relevant and reliable ideas to be elaborated further, even to minimum viable products/services. All this is achieved very fast, allowing more time for the later phases of the innovation process.

Keywords

open innovation, innovation, innovation process, minimum viable service

Introduction

Innovations, including innovative methods and practices, are essential for companies and universities as well as public organizations. The competitive advantage is more and more based on innovation capability in services, products and business models. In knowledge-intensive sectors, such as IT, health care, design, high-tech, and professional services, organizations can benefit from new, fresh ideas from the young generation in their services development. Often external non-ordinary resources are required to make innovations.

Universities aim to network more with external partners to enhance learning and to make a larger impact on the surrounding economic activities.

Often universities lack an understanding of how to enhance the creation of new business innovations and how to promote joint activities with companies. Based on this pilot project, the Innocamp method offers unique new value through joint activities, where company managers, students and teachers work simultaneously and hands-on over a short intense period. This means improvement in innovation performance for organizations and excellent learning experiences for all participants.

The objective of the InnoCamp method discussed in this paper is to create service/product innovations faster, applying a user-centric open innovation approach. In concrete actions, this means that the InnoCamp method aims at creating a vast number of fresh ideas and at coming up with minimum viable concepts rapidly, from which the commissioning parties can select the most feasible ones for further development and implementation.

Typically in the past innovation projects carried out together with universities and commissioning partners, different domains are separated during the process. The challenges usually faced in those past projects were: (1) too long lead time from the companies' point of view, typically a few months, and (2) ideas proposed are largely non-realistic as they are created among students themselves alone, ignoring value-adding interplay with substance-matter experts during the whole innovation process. The InnoCamp model discussed in this paper provides tools to overcome these issues.

In order to improve the current state, the InnoCamp model brings together multi-disciplinary university students, service innovation commissioners (companies in this case), coaches as well as the physical place (authentic service/product use environment) to work effectively. The coaches are selected teachers from universities. All participants work together hands-on in mixed teams through the whole two-day project. This enables continuous interplay between fresh ideas, old theories and real-life circumstances.

The InnoCamp pilot project also focuses on the increasingly important strategy to break out of the competition and focus on disruptive innovation. Students learn to develop products and services with an out-of-the-box attitude, not relying on traditional market research orientation. A disruptive innovation often necessitates the impulse from outside the company, triggered by unbiased contributors not involved in the everyday business conduct. Methodically this means that students trigger the process and will be supported by the companies and the coaches.

Literature review

Generally speaking, innovation does something different and it includes something original and distinctive but useful for somebody. Therefore, innovation should create new practical use value and monetary value for someone, otherwise it is only an invention. Innovation takes place in a creative process where humans solve problems or fulfill wants or needs in an original way. Innovations can come into existence by incidental or logical reasoning processes, and, in the end, innovation changes something. Hence, innovation is more than traditional improvement.

In today's business life and education institutions, innovation as a term has become almost a buzzword. Its focus has nonetheless changed during the last decades. As Kelley (2010) says, there were two main focus areas of innovation in the 1970s. The first one was on boosting companies' research and development capability and the second was personal creativity to harness a person's imagination to invent breakthrough ideas. Nowadays, the movement of open innovation has radically changed the role of innovation activity. Innovation is neither isolated to the research and development (R&D) departments nor seen as just creative problem solving. It is essential to involve end users, customers and other stakeholders in the innovation process.

Innovation as an activity is closely related to the maturity of the markets. New innovations can impact the market dynamics, they can create new rules for the markets, or they can even create totally new markets. As Moore (1991) has stated in his well-known book "Crossing the Chasm", it takes time before new high-tech innovation adapts to the mass markets. In the early phase, only early adapters and other tech enthusiast are interested in adopting a new technological innovation. They are visionaries who are more interested in new gadgets and an innovation itself than in its benefits and practical value. He describes the gap between the early market and mass market as "the chasm".

There is always some difficulty in transition from one user group to the next. Therefore, it is hard to predict when new innovation breaks though. Although new innovation may rapidly receive some customers - which are usually early adapters and visionaries - it may take from a few months to several years before the market is mature for scaling and rapidly growing business. Ries (2010) highlights the involvement of early adapters and visionaries in the innovation process, because it is possible to start a fruitful learning and discovery process with them by testing and measuring iteratively the minimum viable products. The paying customers do not necessary explicitly know what they need or want, but they can give comments and suggestions for visualized drafts and prototypes. Those comments and feedback work as guidelines in searching for the elements of successful innovations.

Each innovation has its own life cycle, and it is mainly dependent on the dynamics of the markets, the replacing solutions, the choices of the end users and the strengthening or weakening factors of the surrounding ecosystems. The critical moment in the life cycle of innovation is called the inflection point, where major change takes place in the market. The use of the new product or service starts to expand and the old one begins to decrease.

Andrew S. Grove, ex-chairman of Intel Corporation, (1998) defines the strategic infection point as a major change that takes place in its competitive environment. It can be a new technology, a major change due to the introduction of a different regulatory environment or a major change in the customers' values. Grove says that *"almost always it hits the corporation in such a way that those of us in senior management are among the last ones to notice… A Strategic Inflection Point is that which causes you to make a fundamental change in business strategy."* The inflection point is always both a threat and a possibility, and new significant innovations often occur in those turning points. It is called "window is open for new business".

The main categories for innovation processes are linear and iterative processes. The simplified categories also apply to open innovation projects. The linear process has well defined phases, usually starting with defining and planning phases and ending up with development and implementation phases. Each phase has its clear role and function, and going backwards is seen as a failure and waste.

For example, Blank (2007) says that, in the traditional linear product development model, going backwards is considered a failure, whereas, in the iterative development model, going backwards is a natural and valuable part of learning and discovery. Ries (2010) also puts emphasis on the cyclical innovation process where going backwards is important for continuous learning and a natural part of development. Blank (2007) continues in his research that, unlike in the linear model, finding the right customers and markets is unpredictable, and developers need to screw it up several times before they get it right. That is why innovation activity is not a straightforward linear process but it requires several iterative experiments before commercialization. Blank emphasizes the importance of the first phases in his customer development model, namely finding out customers' real problems and needs (customer discovery) and building of a sales model that can be replicated (customer validation). Only after these phases is it relevant to begin investing in company building, increasing fixed costs and resourcing other functions than customer insight operations.

In several everyday discussions among developers and service designers, iterative processes are emphasized and promoted, whereas linear innovation processes are seen as outdated or out of fashion. However, the linear process has a clear role in the innovation and development process, where the problem is well defined, the market is getting mature and the potential solutions are known or at least easily figured out (Ries, 2010). Such processes do not include major economic, social and technological risks, and their management, planning and implementation are usually straightforward and easily scheduled and budgeted. Furthermore, those processes seldom produce disruptive innovations, which are typically launched by startups or other small companies rather than by large corporations (see e.g. Lal and Lanagan, 2002). Christensen (2002) calls this phenomenon the innovator's dilemma.

Hippel and Krogh (2003) present two main motivation-driven models for innovation activity: "private investment" and "collective action" model. They argue that, in the first model, innovators receive returns from the selling of private goods and intellectual property rights. In other words, the "private investment" model typically expects financial rewards from innovations. The "collective action" model expects public good instead of financial prices for innovators, as the results are freely delivered. The open source software project is typically seen as an example of the "collective model" although Hippel and Kogh (2003) see it rather as a "private-collective" initiative. The public scientific results produced at universities across the world are also examples of collectively produced results, often produced for "common good". Therefore, the source of motivation to boost and drive innovation activity is not necessary just an economic or commercial interest.

It is commonly accepted in that research community that factors influencing new innovations typically are: diversity in teams, interaction and sharing within the team, multi-disciplined and multicultural teams, positive working spirit, basic knowledge and personal experiences on the field, freedom in terms of spending time, as well as a "mistakes accepted" atmosphere. Open innovation methods try to enlarge innovation activity from the research departments to the customer and end users interface where products and services are used. This makes innovation activity more diversified, multi-discipline and multi-cultural, as the end users and other stakeholders have a possibility to participate in the development processes. It is also supposed that they could have a practical viewpoint on the needs, challenges, latent values, emotion and motivation, namely the origin of innovations.

Methodology

The methodology used in the InnoCamp working is based on social constructive learning theories where learning is seen as collective building of knowledge. Students and teachers together with company representatives form a two-day learning community, where they work in collaboration creating socially shared meanings in different tasks assigned. Mutual feedback is an important part of a social constructive learning process. It is versatile and flexible peer-to-peer activity throughout the process.

Various creative problem solving techniques are used in this project. In creative problem solving, a good command of communication skills is a prerequisite. These skills include speaking, listening, negotiating, argumentation, questioning and summarizing. It is also vitally important to understand different learning styles of the participants. Therefore, besides auditive methods, visual and kinesthetic approaches will also be used to utilize the full potential of the group. The ability to move between eloquent and systematic stages in the process is extremely important to get results from creative problem solving sessions.

Creative problem solving consists of the following stages: problem definition, fact finding, idea generation and acceptance of the solution. The process is not linear but typically cyclical or iterative. For example, problem definition will have to be clarified several times in the process. It is important to keep idea generation and selection of the solution apart from each other, since evaluation of the solution is likely to stanch the generation of ideas.

At the beginning of the camp, special attention is given to group formation in order to enable effective interaction and sharing in the team. Also, attention is given to building a positive atmosphere to promote a free flow of ideas. Collecting participants in an isolated environment where there are no distractions and where everybody has to stay until the end of the camp builds a learning environment with unique possibilities. It is important to use the limitation of time and space to build positive pressure in the groups' work. However, it is equally important to have regular breaks where hard work is paused and groups can e.g. have some exercise together or enjoy refreshments. Music is also used for both relaxation and energy. Since participants stay overnight, it is possible to prolong the days if needed. To build trust within participants, it is important to spend non-scheduled time together in the evening as well.

The selection of group methods is dependent on the problems handled. However, it is important to use several methods within one camp to support persons with different learning styles and enable variation in group work. The methods include but are not limited to:

- Different role plays, where company product/service is used in an innovative way and participants are given roles from which they address the subject.

- Helicopter method, where the problem is observed from a faraway perspective to find new insights.
- Future scenarios (what if?), where participants create different future outlooks to find the gap between today and tomorrow.
- Creative process writing to find the oddest ideas and share them with others who can develop them further.
- Visual methods, such as using pictures to combine different product/service features.
- Body storming, where participants walk and write ideas on posters as well as build new content on each other's ideas.
- Open space, where participants work in freely formed groups, each addressing a different theme.

The InnoCamp process

The innovation process used in the InnoCamp project is illustrated in Figure 1 below. Prior to the InnoCamp, there are a virtual team formation phase and personal pre-assignments in order to gain personal use experiences from the products and services under development. Pre-assignments include, for instance, using the product and services, mystery shopping and competitor analysis tasks. The InnoCamp itself starts with a kick-off session to motivate people, followed by an idea creation session. Each team is requested to come up with 100 new ideas during the first morning session. The InnoCamp ends two days later with the presentation and testing of the minimum viable services/products (figure 1.). A specific set of tools is applied in each phase of the innovation process. The process is strictly guided step by step and compressed into two working days. Teams have dedicated coaches who offer them specific tools for each phase of the innovation process. This approach fosters mutual exchange of knowledge, fresh ideas and experiences throughout each step of the process. Working is target oriented and strictly facilitated to bring deliverables in each stage. The purpose is to find an optimal mix of strict target-oriented periods and time as well as free unscheduled time for the teams.

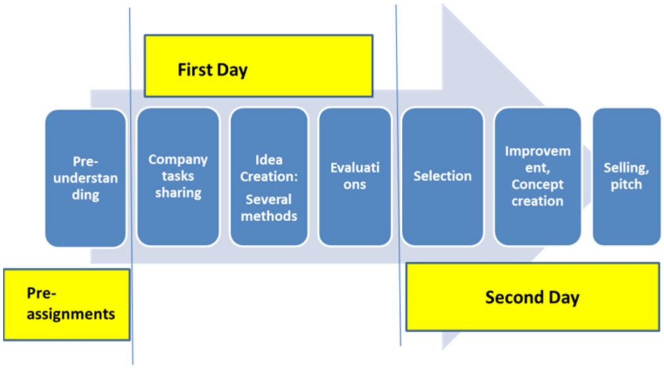

Figure 1. The InnoCamp process with pre-assignments.

Each process phase includes specific tools offered to the teams. In most of the phases, there are optional tools that the team may select itself. The tools were packaged into a "toolbox". The toolbox was presented by the coaches. Afterwards, anytime in the process, the team had the possibility to apply any of the tools available. It was allowed to iterate and come back to earlier phases whenever needed. (Taatila & Suomala 2008; Ojasalo et al 2009)

Testing the InnoCamp model

Five sporting companies participated in this InnoCamp pilot project. They were looking for new ideas and potential solutions for their sporting products and services. The assignment was defined together with the organizers and company managers four weeks prior to the camp itself. The company managers spent the two days in the same place as everybody else in the camp. At the end of the two days, the teams presented the results to the company managers in a form of a pitching presentation.

University students were invited from ten different universities in Finland, Estonia and Germany. There was a great variety of different disciplines from art & design to engineering and geology. The coaches decided on the team formation to ensure as equal a composition as possible. Altogether 50 students were invited, divided into ten teams. Thus, each company offering assignments were given two competing teams to work for the same assignment. Each team was assigned a dedicated coach, each coach working with two teams simultaneously. The coach was responsible for guiding and supporting the team, however, staying in the background as much as possible in order to demonstrate that the students were responsible for the job and the

results. The company manager's role was to do interventions in pre-defined phases of the innovation process. During those sessions, interplay and sharing of ideas and knowledge took place.
The research part was conducted as qualitative research, as a single case study. This fits well for evaluating a new phenomenon from which prior knowledge is not available (Ghauri & Gronhaug 2010). The objective was to evaluate the effectiveness of the InnoCamp model and to find evidence on what works and what does not work so well. Therefore, the aim of the case study was to collect information and understanding from real situations and experiences (Hirsjärvi, Remes & Sajavaara 2009; Ghauri & Gronhaug 2010).

Data was collected two weeks after the InnoCamp ended by interviewing all five company managers. The company managers were already asked to participate in the study prior to the camp implementation. The purpose of the interview was to develop an understanding of the experiences of the company managers as well as of the concrete results they achieved as an outcome of the project. The interview was implemented as a semi-structured interview including five questions. All the answers were written down during the interview. The interviews lasted approximately 60 minutes each on average. The data analysis phase was done using content analysis. The researcher doing the analysis was acting as one of the coaches during the test project.

Results

The research data shows that the presented InnoCamp method can produce potential new innovations in a fast and effective manner. The commissioners were able to utilize the new InnoCamp method as a complementary booster to foster innovations within their organizations. Broadly speaking, the benefits were threefold: (1) direct results for business development, (2) new networking connections with universities, students and companies from the similar business field, and (3) new type of thinking learned during the process.

Regarding the first domain, the direct results for business were that commissioning parties were satisfied with the concrete concept ideas and minimum viable products they achieved as outcomes from the InnoCamp project. The outcome from the project can be quantified as follows: Tens of new relevant and applicable ideas out of a total of about 700 ideas, and a handful of new minimum viable products/services that led to further development and implementation. This enabled commissioners to connect new proposals back to their mainstream development processes in order to proceed to the final phase of the innovation process – implementation and leveraging. According to the interview data, the Innocamp method tested in this project offers a great extension for companies' own innovation processes and makes it possible for companies to capture the innovation potential among a large number of multidisciplined young adults. The Innocamp model is relatively easy for companies to adopt due to the short timeframe spent on it.

In terms of networking and new connections, companies found several new possibilities for collaboration. The co-working established new connections between commissioning parties and universities, as well as between commissioning parties themselves. Companies were planning to carry out thesis projects and other smaller study projects with universities. With students they found interesting recruitment possibilities and even made a few agreements for work projects. Students themselves were highly motivated and valued conversations and interaction with company managers. Companies also identified and started joint business development projects themselves.

Finally, the third domain of the results indicates that experts from the commissioning parties learned new ideas and ways of thinking from the young generation during this project. New thinking approaches from the youth renew the managers' thinking. This is something that is very difficult to achieve without collaborating and working closely with the young generation. Established organizations tend to be full of mature structures, operating models, beliefs and practices leading to "old type of ideas only". Those legacy structures are inherently limiting the innovation potential in the organizations. Moreover, on a personal level, all participants felt that the project was an inspiring, positive, fun and useful experience.

The research data suggest that the biggest factors influencing the success were as follows. (1) Responsibility for the results was clearly given to the teams. This created a feeling of ownership and trust among the students. They felt capable of working equally with experienced company managers. (2) Pre-assignments that provided the university students with user-context understanding and personal experiences on using the services and products. (3) Mixed teams of multidiscipline university students integrated with substance matter experts. (4) Team formation took place virtually through social media prior to the two-day camp. 5) Set of tools proposed for each phase of the innovation process. (6) The role of the coaches to coach the process, offering both freedom and strict directions in feasible intervals.

Conclusions

The research data suggests that open and participatory innovation processes can be speeded up and made more effective by adding new components into traditional university-driven innovation projects. Such empowering ingredients include shortened lead-time, strong target oriented approach, clear timelines and objectives for each process step, virtual web-based team formation prior to actual working, coaches for multidiscipline teams, and pre-defined set of idea creation and problem solving tools for each process step. The tested InnoCamp model demonstrates that two intensive on-site days are enough to go through most of the innovation process phases and yet come up with valuable results.

By utilizing this novel systematic method, organizations looking for innovations can achieve new ideas and minimum viable products/services in a fast and easy-to-adopt way. The value of the InnoCamp model is well summarized in the company managers' statements, saying they all are willing to join again in similar type of projects.

The findings of this case study mainly support the extant literature on the field. The research data supports earlier findings suggesting that diversity in thinking styles supports innovativeness (Taatila & Suomala 2008). However, the mix of nationalities in one team was not clearly seen beneficial. Some interviewees thought several nationalities may hinder the performance, whereas others just saw it as a positive factor in achieving the results. The results also support the idea that team formation and spending time together prior to critical co-operation activities is an important criterion to succeed. In this project, this was mainly performed virtually on Facebook prior to the camp in order to win time. This made face-to-face time more effective, as team formation had largely happened virtually prior to the InnoCamp working.

The interview data suggest one interesting thing that is somewhat contradictory compared with the common view in the extant literature: In this project, strict timelines were seen as useful and even one of the key factors in achieving the results, even if control and strict timelines are generally speaking understood as having a negative impact on innovation performance (Ojasalo et al 2009). Perhaps the key here was the variety of hectic and free periods, changing modes to reinforce a different type of thinking and atmosphere over the working process.

The presented and tested InnoCamp model provides an applicable basis for any organization to reinforce their innovation capability. The model can be customized to various needs and use cases. It is relatively easy to organize as a first step in a roadmap towards modern open and user-centric innovation operations. Organizers need to pay attention to selecting motivated participants and to recruiting professional coaches to guide the teams through each step in the rapid two-day innovation process. By further standardizing the procedures, the InnoCamp model can be made repeatable and even more valuable for a bigger number of organizations.

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About the Authors

Timo Kaski, HAAGA-HELIA University of Applied Sciences, Finland

Ari Alamäki, HAAGA-HELIA University of Applied Sciences, Finland

Anu Moisio, HAAGA-HELIA University of Applied Sciences, Finland

You Say You Want a Revolution…

Magdalena Goryczka, Centre for Innovation, Technology Transfer and Development of the Foundation of University of Silesia in Katowice, Poland, Ewa Osuch-Rak, Institutue of Fundamental Technological Research, Polish Academy of Science, Warsaw, Poland,
Agata Prokop, Institute of American Studies and Polish Diaspora of the Jagiellonian University, Cracow, Poland,
Aleksandra Szulczewska-Remi, Department of Controlling, Financial Analysis and Valuation, Poznan University of Economics, Poland

Abstract

TOP 500 Innovators Program Science-Management-commercialization is the only comprehensive and wide-ranging training program in the world addressed to scientists and technology transfer people. The program, initiated by the Ministry of Science and Higher Education in Poland, offers the participants a 2-month course at universities of the top ten Shanghai ranking (so far at UC Berkeley and Stanford University), during which they participate in lectures, seminars and workshops on commercialization, business strategy and leadership.

Americans emphasize the revolutionary nature of this project, its massive scale (the end of 2015 planned a trip for a total of 500 Polish sparticipants) and the possibility of creating a critical mass that will allow to make the necessary change of mindset and reforms in the system of science in Poland.

Keywords

Innovation, commercialization, science, management

Introduction

Commercialization of academic discoveries and cooperation between universities and business has been the topic of broad discussion for the last decades. But the majority of research universities worldwide have static structures and business models inefficient in a changing global economy. According to this German von Humboldt model, universities have basically two missions: teaching and research whereas the most recent one is so called "third academic mission" – contribution to economic development.

"We all want to change the world…"

Many research institutions have built numerous barriers limiting academic entrepreneurship and few offer incentives for scientists to leave the ivory tower to commercialize their research. So far Poland has been mirroring the traditional model of university but its rapidly growing economy calls for more. Since innovation is heart of economic growth, Poland needs more challenging technology transfer model, ordinary models will not suffice.

"You tell me it's the institution…"

Governments are usually considered to be the last to develop innovative programs to foster technology commercialization. But the Top 500 Innovators – Science – Management-Commercialization Program implemented by the Ministry of Science and Higher Education (MNiSW) in Poland is a refreshing exception. The program identifies 500 early to mid-career leaders in research, technology and tech transfer across Poland and immerses them in an intensive 9-week program on innovation and technology commercialization in Silicon Valley.

"Top 500 Innovators is the largest ever training program for those involved in scientific research and commercialization of the research results. I believe it will revolutionize Polish thinking about cooperation between science and economy." - says the Minister of Science and Higher Education, professor Barbara Kudrycka, who also points out "...together we are building a new culture of innovation."

According to Dr. Peter Fiske, faculty co-director of the program at the Haas School of Business in Berkeley, the Top 500 Innovators program is unique and unprecedented. Never before has any government sent such a large cohort of academic professionals to major business schools for intensive training. 500 people makes approxiamtely 1% of all Polish scientists' population.

Cohorts of 40 individuals are sent to either U.C. Berkeley or Stanford for an intensive program. Piotr Moncarz, consulting professor at Stanford Univeristy, mentions key elements determining the uniqueness of the program: i.e. working in truly interdisciplinary groups and close/personal/direct contact with experts from various fields (eg. team building, starting business). Participants learn how to make research a pleasure and how to turn their ideas into profit.

"You better free your mind instead…"

The "Toppers" (as program participants call themselves) are exposed to the latest technology transfer practices, and explore the development of new business models in and out of academia. They spend days with leading technology entrepreneurs and experience first-hand the Silicon Valley mindset that has enabled the launch of many global companies such as Facebook, Google, NASA. The participants also absorb the culture of cooperation, collaborating on internship projects. They learn to internalize the "it's OK to fail' message and find out how to be effective leaders and agents of change. Lectures by some of the foremost experts in communications, team building, forecasting, and strategy, offer a window into a modern understanding of the innovation process.

The programs at U.C. Berkeley and Stanford focus on somewhat different subjects. Participants at Stanford University focus on design thinking, whereas those at UC Berkeley focus more attention on managerial issues and entrepreneurial skills. Grzegorz Robak, project coordinator at the MNiSW, emphasizes that both universities have been selected because they are in the top five of the Academic Ranking of World Univeristies (Shangai list) and they are leading in technology transfer.

"You say you got a real solution…"

Is American entrepreneurship spirit contagious? Do the Toppers believe they can make a difference and change the culture of Polish science? Those who have already completed the program seem to think so: many of them have returned to Poland and launched start-ups or initiated programs at their home universities to promote cooperation between business and academia.

A participant of the first edition, Marcin Binkowski, established in 2012 "n-LAB" specialized in designing 3 D face models for reconstruction surgeries. Another innovator, Katarzyna Grabowska, Ph.D. found an American investor who will assist in commercialization of a new type of intelligent material. Yet, Bartosz Sakowicz launched the Interdisciplinary School of Innovation at Łódź University of Technology. Graduates of the program are also active in the Polish-American Innovation Hub and collaborate with centers in Silicon Valley. Thanks to their initiative the representation of Plug and Play Tech Center in Poland has been established.

"Don't you know it's gonna be all right…"

Investing in 500 young individuals will probably not build another Silicon Valley in Europe. But it will certainly lead to promising new initiatives in the Polish academic environment. Professor Moncarz thinks that 500 people are a critical mass which can crush the rock but only if it speaks and acts in one voice.

The authors of the article and particpants of the programme at the same time believe that unmatched networking between them and their mentors will forge many great ideas and opportunities. Some of us will set up our own businesses and some will find the inspiration to lead our organizations as true leaders into the future. We want to bring new energy and new knowledge supporting universities to improve the process of commercialization of knowledge and change science in Poland.

Acknowledgement

We would like to thank Dr. Peter Fiske, faculty co-director of the Top 500 Innovators program at the Haas School of Business in Berkeley for his asssistance, expert guidance and support while writing this article.

About the Authors

Aleksandra Szulczewska-Remi is an Assistant Professor at the Poznań University of Economics, Department of Controlling, Financial Analysis and Valuation. She is also a member of Top 500 Innovators Association as well as Innovation and Knowledge Transfer Commission at the Faculty. Her current research interests are focused particularly in the area of Innovation, Knowledge and Technology Transfer, with emphasis on innovation financing and innovation value.

Magdalena Goryczka is a specialist for scientific research management and commercialization of research results and regional development. She graduated Political Science and The European Union Law at the Jagiellonian University. Her prime area of interest is regional development and innovation. She is also an expert of European funds.

Ewa Osuch-Rak holds a position of an R&D project manager at the Institute of Fundamental Technological Research, Polish Academy of Sciences, in Warsaw. In 2013 she graduated from an MBA-level programme at the Haas School of Business, University of California, Berkeley. She received M.Sc. degrees in economics (Warsaw School of Economics) and electrical engineering (Czestochowa University of Technology) in 2009 and 2011 respectively. Now she is a Ph.D. student at the Warsaw School of Economics.

Agata Prokop is currently employed at University of Agriculture in Cracow in Technology Transfer Office. She specializes in transfer of technology, patents, IP issues and economic law. She graduated Finance and Banking at the University of Economics in Cracow and law at the Jagiellonian University. She has recently defende her PhD thesis "Economic consequences of terrorism. Case study of USA". Her prime area of interest is globalization and innovation. She is also interested in economic consequences of terrorism.

Teaching Methods and Outcomes of Multidisciplinary T Workshops

Chia-Hui Chiu, College of Humanities and Social Science, Taipei Medical University, Taiwan,
Pei-Ling Liu, Institute of Applied Mechanics, National Taiwan University, Taiwan,
Shih-Chung Kang, Department of Civil Engineering, National Taiwan University, Taiwan

Abstract

This study presents an ongoing project aimed at developing an effective method for cultivating students with a multidisciplinary capacity. This ongoing project, known as "T Workshop", has been developed based on three main elements: (1) A dual-instructor system is used to (2) develop a monograph (on practical problems and solutions) while (3) working with multidisciplinary peers. In the past year, eight T workshops were held with 16 professional instructors and 210 students from different fields. The feedback from the instructors and students indicate the ability to both communicate and collaborate with multidisciplinary peers and the cultivation of soft power progresses through the T Workshops. A qualitative research method was used to interview the students who participated in the experimental and control groups, and their performances during the workshop were analyzed. Through discussion and analysis, we found out how the students presented their learning outcomes in terms of what they saw or did during their workshop internship. The aim of the study is to ascertain the long-term effects of the T workshop.

Keywords

multidiscipline, T-shaped professional, problem-based learning, experience education

Introduction

There are two educational issues in Taiwan, the lack of integration of multiple types of education and the multidisciplinary elite of communication. This study attempts to import an innovative teaching model through the promotion of T workshops.

The "T-shaped professional" concept has been promoted by Prof. Dorothy Barton from Harvard University. In her book entitled, *Wellsprings of Knowledge* in 1995, she took examples from companies such as Microsoft and HP to explain the need for such talents. Instead of looking for an I-shaped specialist, who only thinks and understands his or her professional field, the market has changed to search for T-shaped professionals, who can work across fields (see Figure 1). The shape of the letter "T" represents not only the acquisition of multidisciplinary knowledge, but also the ability to communicate with others from other disciplines, which is crucial [3]. The T workshop essentially focuses on cultivating multidisciplinary skills, communicating with other disciplines, and generating creative and efficient solutions. "In its early stage, the T-shaped profession means to obtain both technology and business skills that helps the industry to analyze and create a better and renew solutions."[6] Nevertheless, the T workshops are not limited to a specific set of two specific fields. With this in mind, we designed different sets of pairs of distinct fields or subjects to be taught in different workshops to develop a new possible teaching pattern that can be integrated into various fields.

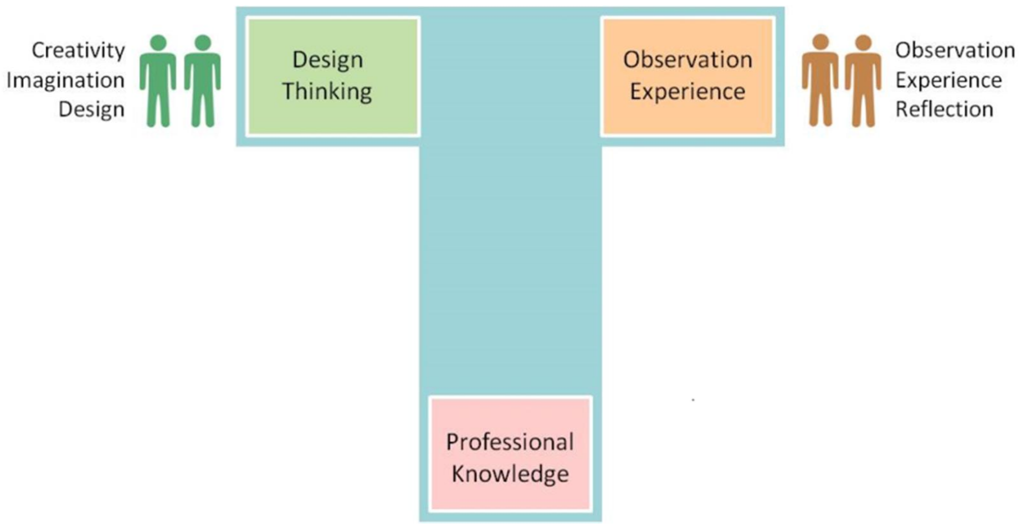

Figure 1. The concept of T-shaped people

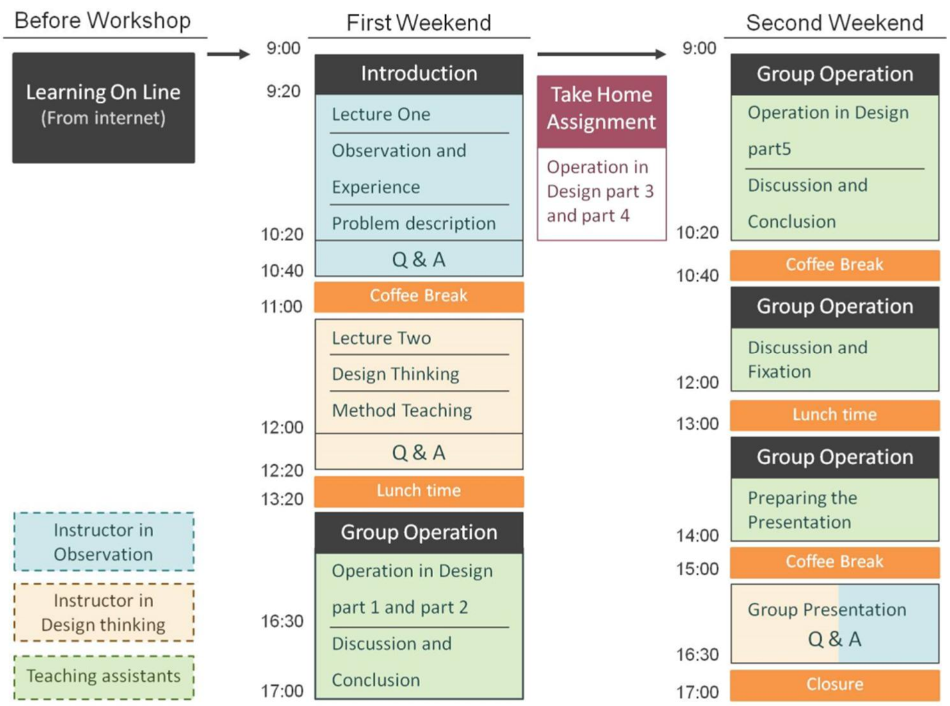

Figure 2. The schedule of T workshop

Background

The goal of T workshop is to build a teaching model for cultivating "T-shaped" professionals, leaders that are capable of interacting and cooperating in a wide range of disciplines and fields. Our workshop combines two professional instructors from problem identification and problem-solving fields to teach students how to reorganize their thinking patterns when identifying and solving problems. By polishing their skills through solving real problems, such as elders' sleeping issues, students are trained while creating actual solutions. This teaching method allows pupils to learn not only knowledge of a single profession, but also how to use different skills from different disciplines to find suitable solutions to problems.

Workshop sessions

The T workshop is based on educational experience. Eight workshops were held between March 2012 and January 2013, in which 210 students participated, led by 16 instructors (2 per workshop). Each workshop lasted two weeks and was structured in the following manner: A specific problem was introduced to help the students understand more about the issue, followed by an introduction of the design thinking methods and the mode of operation. In the afternoon, students applied what they had learned to practical activities and they were given a week between sessions to generate creative ideas. In the second week, they presented their solutions or prototypes of their designed products and shared what they had learned throughout the process (see Figure 2). Students were given small homework assignments to help them practice how to observe and develop ideas. Details of the session categories are shown in Table 1.

Table 1. Categories in Workshops

Workshop	Category of Problem	Discipline for Solving the Problem	Number of Participants
Fun in Food x Design Thinking	Elders' Diet	Industrial Design	26
Healthcare x Design Thinking	Elders' Board Game	Industrial Design	30
Great Help for Elders x Engineering New Sensations	Elders' Furniture	Engineering Design	31
ICT Technology for Elders x User Experience Design	Elders' ICT Technology	Industrial Design	45
Lifestyle of Aborigines x Service Design	Elders' ICT Technology	Service Design	21
Advanced Level in Aboriginal Culture	Medical Service Deficiency in Tribes and Heritage in Aboriginal Culture	Oral History	15
How Elders See Color × Graphic Design	Elders' Sight	Graphic Design	24
Healthy Diet × Design Thinking	Nutrition Healthcare	Industrial Design	18

Table 2. The participants' reflection in each workshop

Workshop	Participant Reflections
Fun in Food × Design Thinking	I have learned to observe more by listening and understanding everyone's perspectives. I felt as if I shouldn't just stick to my own major, which is the Medical field. What I should really do is walk outside of the box to experience this big world and the future.
Healthcare × Design Thinking	I have discovered that every field has different considerations while facing the same problem. Some focus on functionality, while some focus on the comfort of elders. I am glad I wasn't stubborn in my opinions in the first place and was able to participate with others in designing products that I am proud of.
Great Help for Elders × Engineering New Sensations	After participating in the workshop, I realized that learning new things can broaden my perspective.
ICT Technology for Elders × User Experience Design	After partaking in the workshop, I now understand that a good design should consider the users' experience and not just the designers' subjective thinking. I've also learned from different points of view and learned different problem solving methods by cooperating with people from different fields.
Advanced Level in Aboriginal Culture	Attending this workshop has provided an opportunity for people of different disciplines to bring various skills to solve one problem. It was new for me. I also learned so many things in the workshop. When I was back in school, I never had the opportunity to cooperate or discuss with others from different disciplines. I have really learned and grown a lot from this experience.
How Elders See Color × Graphic Design	In traditional classes, we are always looking for the right answer. Even in PE class, we were asked to have perfect posture. This "perfect" has suppressed our original creativity. While in the workshop there is no correct answer, we are looking for ways to design a product that is both practicable and attractive to the elders. If we miss these considerations, the design would be useless because no one would use it. What was most surprising to me was how big the gap is between what we think is true and the reality, such as between what we thought the elders wanted and what they actually wanted. It made me realize that certain things can only be understood on a superficial level.

Following the eight workshops, we discovered the three main elements of a successful T workshop. First, a dual-instructor system, in which one instructor introduces the problems, while the other presents methods to help the students find the solution. Second, monograph development, by which participants are put in teams to discuss different topics and develop their monograph in the workshop. Third, collaboration with multidisciplinary peers: the teaching assistant helps to put participants from different backgrounds into groups, thus enabling participants to practice multidisciplinary communication skills while cooperating with one another in the workshop.

Methods

The study explores the long-term effect of T workshop using both an observation method and a qualitative interview research method. Five gerontology health management students were classified into two groups: an experimental group, those involved in the T workshop, and a control group, those who were not trained in the T workshop. In-depth post-workshop interviews were carried out to collect qualitative data on the long-term effects of the two groups. Data analysis followed a grounded theory method using a subject-extraction process.

The five participants, labeled A to E, are described in the form. Wide representation and suitable diversity were the main concern when conducting sampling in this study. Three participants form the experimental group, and the other two students are considered the control group. Students in both groups participated in the interviews during their elective practical courses, internships, and professional service learning courses. Students A and B were training at an internship in a faculty at the same time, while students C and D were in the process of doing the professional service learning program and shared the same senior.

Code	Description	Group
A	• Gerontology health management senior student • Completed two T workshops, a caddie project, and a shadow project • Completed professional service learning program • In the process of doing an internship at a hospital	experimental group
B	• Gerontology health management senior student • Did not complete a T workshop • Completed a professional service learning program • In the process of doing an internship at a hospital	control group
C	• Gerontology health management junior student • Completed two T workshops • In the process of doing the professional service learning program	experimental group
D	• Gerontology health management junior student • Completed one T workshop • In the process of doing the professional service learning program	experimental group
E	• Gerontology health management junior student • Did not complete a T workshop • In the process of doing the professional service learning program	control group

Three qualitative interviews were carried out on 9, 10, and 11 January 2014, with each interview lasting two hours. The questions focused on the students' performance on their ongoing courses (internships or professional service learning). Using qualitative research coding, the long-term effects of the effectiveness of the T workshop were analyzed.

Results

Several observations can be drawn from comparisons of the qualitative data to effectively evaluate the efficacy of the students who participated in the T workshop.

4.1
Students in the experimental group describe their academic performance using the analysis code words, "design, observe, experience, and compassion" three times more than students in the control group. In response to questions on the stimuli for activity design or observation experience, up to two thirds of the students attribute them to their experience in the T workshop. Overall, the results indicate that the T workshop is effective for teaching both activity design and observation experience.

4.2
The questions that remain are: (1) How are subtle differences distinguishable between the students from the qualitative data? (2) What kind of learning outcome do the students from the experimental group present? (3) How do they present their learning?

The first aspect to consider is the skills learned in the T workshop. The students from the experimental group commented on the practical section from the workshop. Student A, who participated in making a handmade book of life, said, "I really hope that the place where I do my internship is able to include reminiscence therapy in the elders' care." After creating an AEIOU statue design, student D stated, "I'm using the skills I learned from the T workshop".

The second aspect pertains to the experience of working with multidisciplinary peers, which helps the observation when similar cooperation occurs. While students participate in their work, such as their internship or during discussions on interdisciplinary issues, they will be more likely to support the initiative on learning opportunities and be more open-minded. For example:

> *"I found that at the facility where we do our internship, when a discussion happens, the nurses will mention about physical status, the nutritionist works on nutrition, social workers will deal with legal issues, and the director will conclude it" (A).*

This detailed response can be compared with a student from the control group (B), who stated "I'm surprised about how difficult it is to get this opportunity to learn", but was unable to describe what he had learned and observed after they calm down.

The third aspect analyzes the continued reflection and introspection demonstrated by the students from the experimental group, who often share their experience of finding a problem and explain what did they did to resolve it. For example:

> *"When we were making the plan to bake some cookies for the elderly during my internship, I was asked to bake the cookies before the day of the activity. At the rehearsal, I realized that I was only able to use half of the flour, and the amount just fit the size of the container, so I found that it would not be able to contain the full amount of flour needed for the cookies on the day"(A).*

> *"When I realized I could not find anyone from the other school to cooperate with, even though I made lots of calls, which went to voicemail or were not answered, I tried to contact them via Facebook asking them to notice the messages"(E).*

> *"When faced with the necessity of listing the questions for the elders during my professional service learning program that the teacher requested of us, I planned for the procedure. After first talking with an elder, I changed the way I asked the questions and did the procedure"(C).*

Therefore, I could easily receive the message of continuous reflection and introspection from my students.

Fourth, and of special note, the T workshop participants were particularly sensitive to human observation. The T workshop's target includes design thinking and observation experience, but not only regarding interpersonal observations. According to the research data, when facing the same field, students from the experimental group are more active. If A and B are both in the same institutions in an internship, though the goal focus was on the administrative operation, the experimental group students were actively expressive during the interview:

> *"Although I couldn't find any problems with the administrative process, I found that the director of the internships agency is a very worthwhile learning object. As she led us, sharing her learning experience, I think she is a great role model."*

In other words, the experimental group students are more sensitive when they learn.

Fifth, the design or user experience-centric concept was not necessarily learned by the students from practical experience and implementing the lessons learned. This result was the most unexpected in the study and surprised the researchers. T workshop continues to import the user experience and lead the students to design. However, we found that whether the student is from the experimental or control group, just listening to explanations of the theory of central user experience （「使用者經驗為中心」) can convert his or her perspective in the later study, despite such listening not necessarily being a practical implementation. As a student of the control group said, "I have heard of universal design, so I know the walking aid which my grandpa is using is not suitable for him in any way." The methods of collecting user's experience data should be more important (B) than concepts.

Conclusion

T workshop is an ongoing innovative teaching model. To verify what students learn from the interdisciplinary teaching method, we are developing a questionnaire for T workshop within the following six months. Assuming four core competences of T-shaped professionals—the ability to observe by experience, the ability to internalize feedback through introspection, design thinking, and interdisciplinary collaboration—we have devised the questionnaire based on these four dimensions. We will complete the questionnaires in fourteen T workshops this year and look forward to the result for improving the success of the T workshop model.

Therefore, quantitative research can never be too careful when probing the tacit knowledge of students, especially regarding T workshops. We will continue to conduct qualitative research on a larger scale, thereby finding a better or more customized teaching model.

Based on the results of the study, the teaching model used in the T workshop is effective in education-oriented courses; it has long-term effects on the trainees participating in internships and the professional service-learning program, for example. This can become the reference point from which to improve the experience of education. The study shows that the T workshop should maintain the practical section of the course, which strengthens the method of teaching more than theory. Further, maintaining the interdisciplinary relationship in collaboration would maintain excellent teaching efficacy.

In the near future, the T workshop is expected to strengthen the educational experience of the courses, and the research might be extended by applying the method to other types of courses.

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About the Authors

Dr. Chia-Hui Chiu is a six year veteran of using oral history and service science to create innovation and interdisciplinary teaching methods in service-learning Field. Meanwhile, Chiu is a historian. By Chiu's speech, researches and scholarly articles, she shares professional service-learning experiences on the websites of General Education TW (http://get.aca.ntu.edu.tw:8080/featured/featured-course-detail.php?course_id=252682) and Smart Talks (http://www.youtube.com/watch?v=XicsX4cioCU). Chiu became the director of service-learning center in Taipei Medical University three years ago. To develop professional service-learning in higher education, Chiu researched and produced unique teaching platform with patent license and technology transfer. Recently, she's applying for NSLC (National Service-Learning Conference) and hosting the roundtable to share her research which she won the prize of Ministry of Education and teaching passion.
Welcome to contact Chia-Hui Chiu:thera@tmu.edu.tw

Dr. Pei-Ling Liu received her Ph.D. degree in civil engineering from the University of California, Berkeley. She joined the faculty of the Institute of Applied Mechanics, National Taiwan University in the same year. She took directorship of the Institute from 2003 to 2006. Her major research interests include structural reliability analysis and structural health monitoring. She has developed several reliability methods and nondestructive testing methods for concrete structures. She is currently the Director General of the Center of Innovation and Synergy for Intelligent Home and Living Technology (INSIGHT Center), National Taiwan University. In 2008, INSIGHT Center grew into a regional research center of smart living technologies. INSIGHT Center now focuses on innovation based on user experience.

Dr Shih-Chung (Jessy) Kang, PhD graduate of Stanford University, currently works in the Department of Civil Engineering at National Taiwan University as an Associate Professor. From 2012, Dr. Kang obtained a three-year project fund from the Ministry of Education of Taiwan. The main goal is to develop a feasible, transferable and sustainable education method to cultivate the multidisciplinary young talents for the aging society. Dr. Kang is in charge of executing the project and makes effort to organize the smart aging alliance which has 12 universities and over 20 professors from varied disciplines in Taiwan. The ongoing project continues spreading the innovative education method.

Towards a Smart Learning City

Yuan Lu, Eindhoven University of Technology, the Netherlands,
Ad van Berlo, Eindhoven University of Technology and Van Berlo Group, the Netherlands,
Hilde Meijs, Summa College Eindhoven, the Netherlands

Abstract

This paper describes a case study that employs a design education approach based on design driven innovation, engaged scholarship and empathic learning principles. Different stakeholders with different knowledge, experiences and skills worked collaboratively in creating open innovation of playful and non-technological solutions to lower the threshold of adopting digital care solutions for elderly people to live longer independently in Eindhoven, the Netherlands. Five parties including (1) elderly at Lokaal+, (2) Summa College; (3) Summa students at Lokaal+, (4) Viedome, (5) the Department of Industrial Design at Eindhoven University of Technology have worked closely to create the intended eco-learning system. The resulted playing cards were considered very useful in stimulating and motivating elderly people and Summa students to learn technologies in care more effectively and in providing technological companies with opportunities to introduce and communicate their solutions to elderly people much more easily than before.

Keywords

open innovation, learning, design driven innovation, elderly, engaged scholarship

Introduction

The global population is increasingly aging, so is the population in the Netherlands. Between 2010 and 2040 the number of people over 65 in the Netherlands will grow from 16% to 26% of the total population (Giesbers, 2013). The increasing aging phenomenon would avoidably present tremendous amount of challenges on economic prospects, physical and social wellbeing in the Netherlands.

Open innovation (Chesbrough, 2003) promotes the idea of sharing knowledge, skills and experiences among different stakeholders when developing products, systems and related services. Although the initial idea and discussion about some consequences of open innovation already took place in the 1960s (Chesbrough, 2003), open innovation has become more or less a practice when dealing with societal challenges including ageing (Keller, Gäre, Edenius, Lindblad, 2009). The open innovation practices have been developed from innovating at the boundary of the firms to innovating with a network of multi-stakeholders including end users. No matter which context open innovation is desired, the initiation phase of open innovation is of high importance to the success of open innovation practice (Tomico, Lu, Baha, 2010). Following the call for guidelines to support the initiation of open innovation (Chesbrough, Vanhaverbeke, West, 2006), a new approach which promotes the thought that designers and designs can play an important role in initiating multi-stakeholder collaboration has been discussed (Tomico, Lu, Baha, 2010; Baha, Sturkenboom, Lu, Raijmakers, 2013). This paper discusses the application of the same principle in the field of learning and community care for the increasing ageing population in Eindhoven, the Netherlands.

To deal with the ageing challenges, different efforts and initiatives have been taken in the Netherlands. Among them, the Lokaal+ situated at Summa College at Willem de Rijkelaan 3 in Eindhoven is a very interesting living lab to be mentioned here. Summa College provides vocational education for both young and old students in many areas including care and wellbeing.

It is important to know that in Engelsbergen, one of the districts in the neighbourhood of Summa College, the number of people aged over 65 is about 28 %. Bearing this context information in mind, Lokaal+, a physical meeting place and a living lab, has been set up at Summa College since 2007 to provide, on the one hand, internship places to care students on school campus, on the other hand, companionship to lonely elderly people from the neighbourhood. Viedome is one of the companies that provide digital home care systems for elderly people. By providing facilities and related services, they aim to enable elderly to live more independent in their own houses. The services are related to health, entertainment, safety, informative and video calling. To test and promote their home care systems they collaborated with Summa College and provided their products in Lokaal+ for Summa students and elderly people to use by setting up the Viedome Experience Centre at Lokaal+ (see Figure 1). However, the Viedome care system has been hardly used since installation. It was not yet clear to the students and elderly how it could contribute to their learning and care experience. In addition, it is difficult for the Summa students to understand the technology because they do not have a technical background. The department of Industrial Design (ID) at Eindhoven University of Technology (TU/e) aims to perform research on, and to provide education in: 'Creating intelligent systems, products and related services in a societal context' (Department of Industrial Design at Eindhoven University of Technology, 2014). They joined the efforts at Lokaal+ in 2013, on the one hand, to get better understanding of the needs of the elderly people, on the other hand, to create new learning and care opportunities for the Summa students, elderly people and the companies involved. In short, there are five important stakeholders present in this open innovation network.

1. Elderly people living in the neighbourhood of Summa College who live alone at home and are willing to participate in well organised social activities. They need to feel ease and welcome at Lokaal+. They should be supported to feel comfortable to interact with modern care technologies so that they can even live longer independently. Moreover the elderly are asked to help us educate Summa students by interacting with Summa students in these activities. This provides the elderly with a meaningful role in this context.
2. Students from Summa College who follow the vocational training for care level 2. This level is about providing home care by providing household help including cleaning and cooking for example. In addition to household tasks a limited amount of care tasks can be learned as well. Students need to develop practical working/training experiences at Lokaal+; including get acquainted with new care technologies. In this way, they will be able to provide care to elderly people using modern care technologies in the future and to stimulate and inform elderly people to make use of different technological facilities.
3. Summa College needs to provide vocational training opportunities to the students in Locaal+ to compensate the lack of internship projects in practice and to provide friendly meeting place and define interesting learning programs that elderly and students can work together.
4. Viedome needs to further develop their distant e-care system so that both elderly people the Summa students are willing to use it. Students and elderly people might provide Viedome with evaluations of the use of parts of the system.
5. ID at TU/e needs to provide learning contexts for their students who can really design for and with the society and create impact. Particularly, in the context of Lokaal+ and Viedome Experience Centre, they need to create opportunities to support the targeted learning of the Summa students and elderly people with the Viedome system.

Figure 1. Viedome Experience Center at Lokaal+

These stakeholders wanted to work together to lower the threshold of introducing the Viedome system to Summa students and elderly people. Eventually they aim to create an eco-learning system that Summa College gets the opportunities to develop the suitable training program related to technology in care, Summa students get the opportunities to learn new care technologies with the elderly people, Viedome gets the opportunities to evaluate their systems, elderly people get the opportunities to learn new care technologies that may be very meaningful for their lives, and TU/e gets the opportunities to (learn to) design for multi-stakeholder collaboration and for meaningful technological innovation for elderly people. In this paper we will discuss how the eco-learning system can be created, what the current solution and results are, what the societal impacts are and what the lessons learned are.

Approach

Traditionally, designers have been actively involved/seen in product development and innovation as one of the functional specialisms, or part of the multi-functional team, or the leader of the new product development (Perks, Cooper, Jones, 2005). Recently it has been increasingly recognized that designers can play a key role in initiating and forming the collaborative network by providing initial design proposition with potential to seduce/convince stakeholders into forming ties for collaboration (Tomico, Lu, Baha, 2010; Baha, Sturkenboom, Lu, Raijmakers, 2013). This is in line with what Verganti (2009) promoted. In his design driven innovation strategy, he suggested that when creating radical innovations designers need to learn to manage the interaction with external interpreters including designers, firms in other industries, suppliers, schools, artists, and the media (Verganti, 2009). Engaged scholarship (Van de Ven, 2007) refers to people with specific and complementary expertise who can support the design of innovation opportunities together, i.e. external interpreters. When creating design driven innovations, designers need to therefore work with engaged scholarship.

Creating an eco-learning system with multi-stakeholders in an open innovation living lab as at Lokaal+ implies that it is necessary to engage different expertise in an education and innovation set up so that all different expertise can contribute to the learning experience and knowledge created there. Two professors at ID TU/e, one with design research experiences in user and business insights in open innovation projects and the other with expertise in design entrepreneurship and design innovation practice, therefore designed one design course for master ID students at TU/e. This course aims to create ideas that can help to lower the threshold of learning the use of Viedome system at Lokaal+. A pressure cooker program was developed to allow the students to work on the assignment in one week.

The pressure cooker course program was designed according to Theory U (Scharmer , 2007), design driven innovation (Verganti, 2009) and engaged scholarship (Van de Ven, 2007). Theory U was applied to empathize with the perspectives of different stakeholders involved by combining the first person and second person perspective from a theory of learning. The professors, Summa College and Viedome jointly defined the design brief. Master industrial design students have followed the course program in one-week time. During this week they worked closely with elderly and Summa students at Lokaal+. Experts from Summa College, one technological design company and one care organization were present at their presentations as industrial panel members, the interpreters and engaged scholarship.

The course program is listed below.

Table 1. Course program

Monday (Nov 11, 2013)	
9:15-9:45	Module kick off
9:45-10:15	Presentation Vogel's
10:15-10:30	Coffee break
10:30-12:00	workshop design driven innovation, competitive advantage, customer journey map and PSS
12:00-13:00	Lunch break
13:00-14:00	1st person perspective: designer's vision on the design challenge through video taking
14:00-14:30	1 minute video presentation: designer's vision, if feasible with initial ideas
14:30-17:00	2nd person perspective: end user/stakeholder sensing through video taking
Tuesday (Nov 12, 2013)	
9:00-9:30	1 minute video presentation: end user/stakeholder perspective, if feasible with initial ideas
9:30-12:00	First ideation
12:00-13:00	Lunch break
13:00-17:00	Further ideation, prepare video presentation following why, what and how
Wednesday (Nov 13, 2013)	
9:00-10:45	Finish concept video presentation
10:45-12:30	5 minutes first presentation to scholarship panel and concept presented in video, following why, what and how
12:30-13:30	Lunch break
13:30-17:00	Reflection and further ideation and improvement
Thursday (Nov 14, 2013)	
whole day	Improve concepts, prepare video presentation following why, what and how
Friday (Nov 15, 2013)	
9:00-10:00	Finish final video presentation following why, what and how
10:00-12:00	10 minutes final presentation to scholarship panel and concept presented in video, following why, what and how
12:00-13:00	Lunch break
13:00-17:00	Final report and reflection

During the course program, the industrial panel provided the student groups with feedbacks at the various presentation moments. The student groups reflected upon these feedbacks consequently. These two types of data were analysed in this paper to demonstrate how this design course supported the creation of the eco-learning system and what the expected societal impacts are.

Results

This section discusses the case results on two levels. On process level, the results at different moments in the course are discussed; on content level, the results with regard to the design challenge (the concept and associated business model) are discussed.

1 Process results

6 master students from ID TU/e have worked on the challenge in this course. They called themselves as "social elderly designer" (SED). They started their design journey by participating the workshop provided by the two professors in which they explain the theoretical background and motivation of setting up such a course and a number of necessary methods and tools that could be used in this course by the students. Special attention was given to provide students theoretical knowledge on the role of design in initiating open innovation and the related methods and tools. After that, the group worked further in the assignment by first sensing how elderly and current young generation would experience when using new technologies from their first person perspective, followed by the sensing the same experience from the elderly's and student perspective in Lokaal+.

From their own experience they knew that the values of new technologies can be sometimes really unclear to the users and even if they are clear the way that the technologies may be just too difficult to start to use. When interacting with staff, students and elderly at Lokaal+, they learned that the staff and students at Summa College may have experiences related using of digital technologies, they have extremely limited expertise on how these technologies work. Their use experiences depends also very much on the user-friendliness of these new technologies. For the elderly people at Lokaal+, they have very limited affinity with new technologies and will only adopt them if the value of using these technologies are very clear and beneficial to them. For the students, staff and the elderly people at Lokaal+, it was unfortunately not clear to them what Viedome system could do for them and they found the system also too complex to use. As a result, the system was very limited used at Lokaal+.

When revisiting the design challenge, the SED team realised that the most important issue at that moment was not how to make the Viedome system easy to use first, but to make it clear to all the users what the system can do for them in simple ways, i.e., how to introduce and communicate the system to its users in non-technical ways. With these insights, they started ideation and decided to apply playful principles such as competition, challenge, fellowship (Korhonen, Montola, Arrasuori, 2009) to design a social quartet card game that introduces the Viedome system step-by-step for both students and elderly to play together. They presented their first idea to the industrial panel at the interim presentation. The panel suggested them to make the values of such game more specific for all parties involved and invited them to reflect further what their position could be in the envisioned eco-learning system. Based on the feedback they further developed this card game and conducted the initial evaluation with elderly at Lokaal+ (see Figure 2). The SED group presented their final result via a movie in which their vision, the concept scenario and the associated business model were explained.

Figure 2: Elderly playing the cards

2 Content results

The final concept was a set of learning cards based on the quartet game rules (see Figure 3). In each quartet one function of the Viedome system, such as video calling or using the agenda, is explained. The first card from the quartet explains the meaning to the elderly. The other three cards explain how to complete the task step-by-step. Through four steps, the card game will help the students and elderly to gain knowledge on the meaning, possibilities and working of the Viedome system. In step one 'the meaning cards' are introduced by the student and personalized by the elderly. In this way a conversation between student and elderly arises on meaning and functionality of the Viedome system. It addresses the motivation of elderly to use the Viedome system and give the elderly the opportunity to write down why they would use this system. In the second step, elderly and student will play the game. In this way, the elderly will become familiar with the different functionalities of the Viedome system. When a quartet sets is collected, student and elderly discuss the different steps. Both elderly and student will gain knowledge about which steps to take to use and complete a function. In the third step elderly became curious about the actual Viedome system and would like to share their experiences with other elderly at Lokaal+. While they play the game with other elderly they can discuss their personal values to learn about the system. In the end of this step a student shows the Viedome functionalities on a computer. Eventually, the elderly will become curious and willing to use the Viedome system. The student can help the elderly to use the Viedome system for the first time at Lokaal+. While many elderly and students will continue to use the system a community arises who share their experiences about the Viedome system. Some elderly can decide to buy the system for home use. Other elderly will become informal promoters of the Viedome system, when sharing their experiences with other elderly. Students will spread the word about the Viedome system when doing an internship or working in the care field.

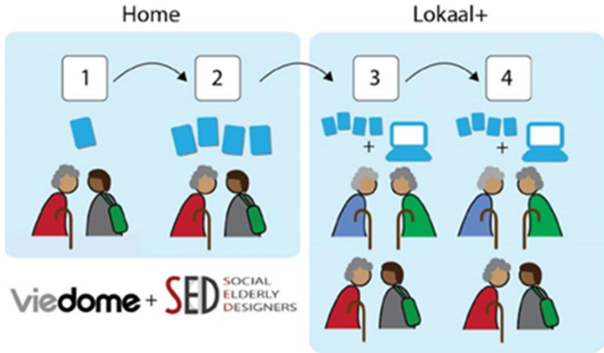

Figure 3. SED Playing Cards

Next the concept scenario, the SED group has also worked out the initial business model in order to realise this concept through the collaboration network. They focused not only on how the SED learning cards could connect different stakeholders in creating (social) learning for all stakeholders and in providing informal care opportunities for elderly people, but also use the SED cards case as an example to illustrate how to develop the open innovation into an eco-learning system and make it possible for companies, who design technological solutions especially for elderly, to bridge the gap between their technological systems and the intended elderly customers. With the SED learning cards, companies like Viedome can differentiate themselves from competitors by promoting their technological products in a non-technological and playful way. With the SED learning cards technological products can be communicated and marketed in a way that suits the elderly target group. In this way, elderly can better understand the meaning of the technological products.

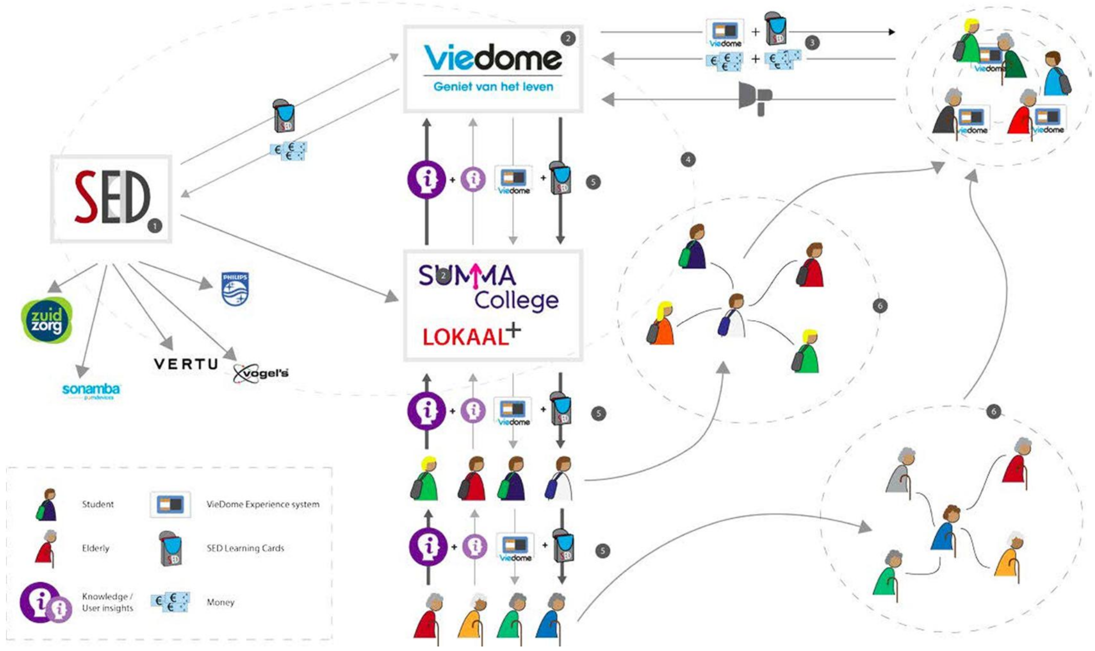

Figure 4. Business model scenario to create sustainable innovation with SED playing cards in open innovation for the ageing society

In the business model proposal, the focus lied in establishing the collaboration between Summa College, Lokaal+/elderly and Viedome. Presently, their collaboration is not yet as beneficial as planned (see Figure 4). The Viedome system was highly technological and not understandable both for the students at Summa College and the elderly yet. The SED learning cards can bridge this gap. The SED learning cards aims to help Summa College to introduce and motivate both students and elderly to work with technological products, such as the Viedome system at Lokaal+. The SED learning cards aims to reinforce the collaborative process between Viedome and Summa College. The Viedome system can be more actively used and generates more specific and detailed user insights about their system. Moreover, both students and elderly become active informal promoters. Overtime, Viedome can become enthusiastic about how the SED learning cards can act as a facilitator in introducing their products to their elderly customers in general. Summa College can be supported to establish a unique educational environment wherein their students work with the newest technology. This prepares them for their future work environments.

Analysis and reflection

The panel feedback and student reflection were made on two levels. One level was specific on the results of the course and benefits for the stakeholders and the other level was on the set up of the design course.

Experts from the technological design company, Summa College and care organization and the two professors found the learning cards idea very appealing. The technological design company found the learning cards a very appealing idea as it will help them introduce their technological products as a facilitator and help the elderly customer group better understand the technological products and increasing the product acceptance. They also realized that such cards create a different way of promoting their technological products than the traditional marketing approach as both students and elderly can become active promoter. Through these cards, more specific and detailed user insights can be created as well for Viedome to continuously improve their system. Expert from Summa College realized that these cards could provide their non-technical care students an easy and friendly way to learn technological products in care together with the elderly people and prepare them to support the technology care service in the future. Experts from the care organization welcomed these cards to train their caregivers with future care technologies. The panel reflected that for Videom, these cards could help them to collect useful user feedback and support them to improve their system further. They realised that if the cards playing is organised well, Videome could received valuable information on what the do's and don'ts with their system, not just on user-friendliness and easy of use, but also on future innovation opportunities. The two professors appreciated the learning cards especially in their ability in reinforce the collaboration between Viedome and Summa College and their strength in communicating technological solutions to the elderly people and collecting related user insights.

Elderly people and students from Lokaal+ who worked with the students during their design process admitted that technology becomes less scary when it is introduced in such a playful way. The SED student groups were very motivated when receiving confirmation of their results from the accelerated learning process. They admitted that they were not able to evaluate the concept completely. However the feedback from the panel encouraged them to continue this project even after the module.

The students found the course program and multi-stakeholder platform in a living lab context really supported them to develop their design competencies in creating meaningful innovative solutions for the given context. The design process proposed in the course program allows them 1) to jump between different perspectives, 2) to be creative in an empathic way, 3) to integrate multi-stakeholder insights into their design process. The resulted design became glue that connects the multi-stakeholder network into a platform to facilitate the learning from different perspectives. The panel commented that although this course only lasted one week, it is already quite evident that the design driven innovation strategy strengthened with engaged scholarship and the empathetic learning approach really can create an eco-learning system that encourages citizens from different social and technological background to learn together and innovate together. They appreciated very much the fact that with this design education approach they were able to let their voice heard and to improve the societal relevance of the university design education.

Conclusion

This paper reported a case study in which a design course was designed aiming to create innovation opportunities in a multi-stakeholder network with strong focus on learning across sectors and elderly independent living. The case results and discussion above have demonstrated qualitatively that the way that the design course was designed (with strong focus on design driven innovation, engaged scholarship and empathic learning) made it possible for every involved stakeholder to learn and develop further. The ID TU/e design students were trained in real life contexts and they developed their design competencies with regards to design driven innovation and designing for and with open innovation networks. Summa College was supported with a set of playing cards so that they could further improve their education program and provide new ways of training their non-technical students in learning technology in care. Students and elderly people at Lokaal+ were able to learn the complex digital system together in a playful manner. Viedome were able to introduce their systems to elderly people and students who initially found it difficult to use the system at all. Viedome had also opportunities to obtain feedback from the students and the elderly people. As a result, it is expected to develop an eco-learning platform through which a longer collaboration among the different stakeholders can be established in and even beyond Lokaal+ and the SED playing cards. Not only the students and the elderly people can learn, but also the technological companies such as Viedome can improve their system and create innovations. In this way, expertise from different areas can be integrated and future meaningful and acceptable care solutions for our increasing ageing society can be created. It is, after all, all about the wisdom of crowd.

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Acknowledgements

This case study would not be possible without the support of a large variety of people. While some are mentioned here by name, this does not exclude all of the others who have inspired and cooperated in this case study.

Furthermore we would like to show our appreciation to Alice van Beukering, Victor Donker, Marlou van der Lee, Rico Sabel and Marije Willemsen who designed the SED play cards in the design education course and also Mark Thielen, advisor to this course, who helped greatly by sharing his knowledge.

We would like to thank elderly people, students and staff from Lokaal+ who voluntarily gave their time and shared their knowledge share their thoughts and expertise with us during this course. Also we would like to thank all the industrial panel members who provided their valuable feedback to our course and results.

About the Authors

Yuan Lu obtained her joint PhD in engineering science at both Eindhoven University of Techology and National University of Singapore. Currently she is working as an Associate Professor at the Business Process Design research group focusing on researching how to create business opportunities by means of field probing to initiate open and dynamic multi-stakeholder innovation, especially for the increasing ageing challenge. Y.lu@tue.nl

Ad van Berlo founded design agency VanBerlo in 1982. He is founding partner of IQ+ Innovation Capitalist. He also is chairman of Capital D/Dutch Design Week, founding father and board member of Brainport Industries and board member of CLICK//Design. Eindhoven University of Technology appointed him part-time professor Entrepreneurial Design of Intelligent Systems in 2013. a.a.j.v.berlo@tue.nl

Hilde Meijs started her career as a physical therapist with interest in the field of management and organization as well. Since 1993 she has been working as managing director in different health sectors, e.g. psychiatry, hospitals care and care for elderly. In 2010, she became principal of a school for vocational training, where around 3000 students are trained each year to become nurses and other professional care providers. hatw.meijs@summacollege.nl

Towards Co-Creation of eHealth Services

Tarja Kantola, Tuija Hirvikoski, Paula Lehto, Teija-Kaisa Aholaakko, Maija-Leena Kukkonen & Sanna Partamies, Laurea University of Applied Sciences, Finland

Abstract

Since the third task of universities stresses the social significance of teaching and research, High Education Institutions (HEI) also have a crucial role in supporting both the creation and uptake of eHealth innovations. This article discusses the background to and processes for how one HEI, i.e. Laurea University of Applied Sciences, has addressed the opportunities and barriers with respect to eHealth in society and in its own operations.

In this article, Laurea University of Applied Sciences' (Laurea UAS) Focus Area Team of Expertise in Nursing and Coping at Home describes and analyses the strategic work done during the years 2011–2013 and the results of its iterative development process. The process of achieving a shared understanding and identifying the needs in Finnish Health Care and Social Services for the future of eHealth was made visible by applying a mixed methods approach.

The article explores technology-enhanced open innovation development in health and social work and the role of one particular HEI in the development of participatory innovation as an example of a Smart City. Apart from cultivating human talent, HEIs have the capacity to enhance citizen-driven innovation using ICT in the field of eHealth. Moreover, often the joint research, development and innovation (RDI) projects organised by HEIs operate as innovation infrastructures. For the case in question, a local innovation partnership boosted and facilitated access to people and resources by using the pedagogical strategy of Learning by Developing and implementing it through Living Labs.

Keywords

eHealth, Co-Creation, High Education (HEI)

Introduction

Currently, European health-care systems are facing severe challenges because public health expenditures in the EU's 27 Member States are growing rapidly (on average, they accounted for 5.9% of GDP in 1990, and had increased to 7.2% of GDP by 2010). The projections show that expenditures may continue to rise to 8.5% of GDP in 2060 due to ageing populations and other socio-economic and cultural factors. As a result, the strong market potential of eHealth has also been receiving more attention (global telemedicine market was $27.3 billion in 2016, with an annual growth rate of 18.6%). The EU's eHealth Action Plan 2012–2020 claims that, notwithstanding the substantial progress of late in the field of eHealth, "barriers continue to exist that need to be addressed in order to reap all the benefits from a fully mature and interoperable eHealth system in Europe".

Since the third task of universities stresses the social significance of teaching and research, HEIs also have a crucial role in supporting both the creation and uptake of eHealth innovations. This article discusses the background to and the processes for how one HEI, i.e. Laurea UAS, has addressed the opportunities and barriers with respect to eHealth in society and in its own operations. Apart from the research, development and innovation (RDI) activities contributing to eHealth, universities' own educational programmes play an essential role in the continuous development of health- and wellbeing-related operations, services and citizens' health behaviour and self-management. Hence, we believe that professional education may increasingly have an important role in tackling the barrier mentioned in the eHealth Action Plan: "Despite the opportunities and benefits, major barriers hamper the wider uptake of eHealth: The later lack of awareness of, and confidence in eHealth solutions among patients, citizens and healthcare professionals." (eHealth Action Plan 2012-2020: Innovative healthcare for 21st century)

In this article, Laurea UAS's Focus Area Team of Expertise in Nursing and Coping at Home describes and analyses the strategic work done during the years 2011–2013 and the results of its iterative development process. The process of achieving a shared understanding and identifying the needs in Finnish Health Care and Social Services for the future of eHealth was made visible by applying a mixed methods approach.

Through their educational programmes and joint RDI projects, HEIs can affect the development of society and its professional operations on both a micro and a macro level. That is, HEIs can develop practices and competences at the individual, organisational and systemic level by applying open innovation principles. The broad socio-economic impacts of the public-private-people partnership and user-centred open innovation ecosystems also call for a transformation in how health and social care professionals are educated. Apart from the professional knowledge and skills related to their own domain and field, a multidisciplinary capacity and knowledge and skills related to open innovation and technology, including attitudes and perceptions, are also required.

Through making these changes, nurses and social workers will become better able to use open innovation and offer technology-enhanced health and wellbeing solutions. Education should provide them with the necessary open innovation principles and design-related tools and methods for co-creating or adopting new eHealth solutions in the workplace.

Laurea UAS's strategic choice is based on the above-mentioned priorities, instruments and opportunities. It has a continuous nine-year tenure as a Centre of Excellence, as appointed by the National Evaluation Council, due to its operative model Learning by Developing (LbD) (see, e.g., Raij, 2006, 2007; Raij & Niinistö-Sivuranta, 2011; Pirinen, 2012, 2013; Kallioinen, 2013), which integrates RDI with learning and regional development. The LbD model, in conjunction with the Living Lab (LL) approach (see, Westerlund & Leminen, 2012), is based on innovative co-creation among various stakeholders within the Helsinki Metropolitan Area and also has an international component (Hirvikoski, 2013; Kantola & Hirvikoski, 2012). It provides Laurea graduates with greater employment and start-up opportunities. Moreover, due to this successful strategic choice, Laurea UAS has a central role in orchestrating national and international RDI operations aiming at joint value creation in the Helsinki Metropolitan Area.

How and why did eHealth become the core of development work in the case of High Education Institutions?

The European Union (EU) has recently focused a great deal of attention on the issue of ageing populations. Supporting healthy ageing means promoting health throughout a person's lifespan, aiming to prevent health-related problems and disabilities from an early age and tackling inequities in health linked to social, economic and environmental factors. (EU, 2012.) Recent years have seen a great evolution in health-care systems as a result, in part, of the rapid development of new technologies, which are revolutionising the way we promote health and predict, prevent and treat illness. These technologies include information and communication technologies (ICT) and recent innovations in genomics, biotechnology and nanotechnology (EU, 2007).

In the future, health care needs to become more cost-effective and better meet the needs of clients. Society has become more virtual as a result of the internet, but the health-care industry is mainly based on face-to-face meetings. However, the present challenge is to develop virtual health care and social welfare solutions. The population is ageing, which is causing increasing needs for health care and social welfare services. Health promotion and guidance should be more a point of focus.

In Europe, it is the role of HEIs to promote knowledge transfer and long-term, systemic capacity building to support European policy for social and economic development, competitiveness and innovation. At the same time, many HEIs such as Laurea UAS have taken advantage of support from the highest political levels within the EU to promote and develop the Open Society Initiative for Europe for their own competitive advantage. Laurea UAS's focus areas and related RDI portfolio have been developed based on the Finnish national innovation policy, they advocate demand and user-driven policy instruments and they provide specific instruments for open and user-driven RDI operations in the field of technology-enhanced services. With these instruments and with the well-educated end-user market, the Finnish innovation environment provides good opportunities for experimenting with new types of innovation and partnership models.

In Finland, health promotion has been a point of focus for a national health-care development. The government has adopted The National Development Programme for Social Welfare and Health Care for the years 2012–2015 (KASTE Programme). The targets of the programme include reducing inequalities in wellbeing and health and organising social welfare and health-care structures and services in a client-oriented manner (Ministry of Social Affairs and Health, 2012).

In 2011, Laurea UAS began focus area work to identify the particular areas that the University is focusing on at present and in the future in order to achieve national and international high-level competence and excellence. Laurea UAS has seven campuses. Each campus, together with the management and employees, selected the focus area/-s best suited to its profile and chose experts for the working groups, called Focus Area Teams. The selection process was based on the definition for national and international networks as well as publications, research, development and innovation activities and their funding. The starting point was also to enhance the staff's and the students' knowledge and skills and to establish start-up companies.

The research objectives and the research questions

The objective of the article is to describe and analyse the Focus Area Team of Expertise in Nursing and Coping at Home's strategic work and results during the years 2011–2013. The aim of the article is to describe how eHealth became the core of focus area work as a phenomenon and as a concept and how it was defined throughout the various phases of the development process and in the research findings.

The main research questions in the article were as follows:

1. How was a shared understanding of the eHealth concept constructed internally at Laurea?
2. How was eHealth evident in the daily work within health care and social services?

Methodological framework

The research site and data creation

The research data used in this article were collected during years 2011–2013 by the Focus Area Team of Expertise in Nursing and Coping at Home. The data consisted of documenting the Focus Area Teams' meetings (plans, memos), the campus meetings (memos, photos, wallpapers), the material produced during the development seminar for Laurea UAS's personnel in June 2012 (memos, wallpapers, presentations) and the snowball questionnaire for experts at Laurea UAS. A literature review on eHealth was included in the Focus Area work as well. The learning tasks (N=105) of Laurea students with respect to their practical placements, one or two per student, made visible the reality of eHealth in health care and social service settings.

The practical/clinical placements (N=116) consisted of various settings in the field of health care and social welfare, such as a primary health-care units, kindergarten, rehabilitation units for elderly people and acute units for specialized medical care. Of the placements, 76 (66%) were within primary services, 60 (52%) were in the area of acute care and 56 (48%) within long-term care. Four (3%) of the placements were in the private sector.

Implementation of a mixed methods approach

The strategic work of the Laurea Focus Area Team was collected and partly analysed and self-reported according using a mixed methods approach (Giddings & Grant, 2009; Curry et al., 2012). The interdisciplinary research team comprised members with diverse professional backgrounds. All group members were higher education professionals with experience in teaching and management. Four members had professional backgrounds as health science educators and researchers-developers with professional experience in public health, pediatric or medical and clinical nursing. One member had a background in both health and educational sciences. Three of the members had done completed doctoral theses.

Flexibility and resiliency were central to the work done by the Focus Area Team of Expertise in Nursing and Coping at Home. The group members brought their organizational and professional affiliations, methodological expertise and identity groups to the work. This level of diversity gave rise to the need to discuss epistemological viewpoints and create a shared language and approach to eHealth during the development process. The team created principles for successful work, including a shared belief in the value of interdisciplinary approaches and the adoption of epistemological plurality in which no single paradigm dominates the venture. The team leader valued interdisciplinary work and the creation of explicit role definitions. The team also developed a common language and chose to use the mixed methods approach when collecting and analyzing the data during the intensive process. The multiple frameworks of the researchers, as well as their diverse experiences, studies and philosophical and methodological frameworks, enriched the results and the conclusions based on the results. The team articulated roles, responsibilities and processes during data collection, analysis and reporting. Finally, the team ensured the time frame and process to enable information exchange by defining deadlines and meeting days (Curry et al., 2012).

During the first stage of the research data analysis, the students' learning tasks produced during different practical placements were analysed in a qualitative context. During the second stage, the learning tasks were quantified with the assistance of the explicit initial eHealth statement produced as part of the focus area work. Photos of the summary discussions taken during three campus road shows and a development seminar for Laurea UAS's personnel were used as stimuli to recall the eHealth co-creation procedure at Laurea UAS. The coding of qualitative and quantitative data was performed in a separate procedure to increase the reliability of the data. The results of the qualitative and quantitative analysis were amalgamated during the final phase of the research. In this paper, the results of a two-year iterative development process designed to achieve a shared understanding and identify the future needs of eHealth were made visible. The findings for the HEI in question (Laurea UAS) epitomise the conceptual framework for higher education in general and work-life co-creation in the future.

The students produced the material during their practical placements in health care and social service settings. Both the quality and quantity of the texts varied. In previous research projects, health care students were able to reflect on their practical placement studies and discuss their learning contexts from the perspective of the working community, the number and relevance of the tasks, the feedback and guidance they received and their familiarity with different points of view (Hulkari & Mahlamäki-Kultanen, 2007; Aholaakko, 2011). The nature of the practical placement was not always carefully described in the texts, but after reading the text it was possible to loosely classify it in each instance.

Qualitative content analysis was used as the principle method for analysing multiple data. The data were analysed in an inductive and abductive manner. (Denzin & Lincoln, 1994; Glaser, 1978; Silverman, 1994, 2001.) During the first phase of the analysis, the data were coded and clustered. The sub-themes were formulated based on the original data and integrated as main categories. Finally, the core categories emerged during the analysis process. In fact, the analysis process also included two iterative processes: analysing the public policy documents and the empirical data. The final findings were based on integrating both processes.

How was a shared understanding of the eHealth concept constructed in the case of High Education Institutions?

Laurea's Focus Area Team of Expertise in Nursing and Coping at Home started its work by looking for national and international publications dealing with themes of expertise for the future. As a result of this work, the team spearheaded the "eHealth" concept.

eHealth was defined as one of the core development objectives at Laurea UAS for the years 2012–2013. An iterative and institution-wide project was initiated to co-create a working theory for eHealth. In close co-operation with the Focus Area Team, nursing students and personnel at three of Laurea's seven campuses created the material needed to clarify the eHealth concept and develop future eHealth services. The material created during the project was analysed to find out how eHealth had become a shared development objective and how the concept was understood and conceptualised at Laurea UAS.

Focus area work was carried out internally at Laurea UAS by the chosen experts. Stakeholders were occasionally consulted. In the future, national and international development work should be considered more closely with the stakeholders. Development days were organised for Laurea UAS's staff in June 2012. The Focus Group, then called the eHealth Team, collected the data in working group discussions. The questions that were addressed were as follows: What is eHealth? What kind of eHealth is needed? What is the future of eHealth?

How was eHealth evident within the context of health care and social welfare?

The identified eHealth services

What kinds of eHealth services did the students report?

Students reported that several eHealth applications were being used in 73 (63%) of the 116 practical placement sites. The variety of applications is presented in Table 1. No eHealth services were being used in three (3%) of the placements (the students reported no eHealth services). In two (2%) placement settings, the personnel did not consider eHealth to be suitable for their patient/clients. In seven (6%) placement settings, the students recognised the use of ePrescription only whereas two placement settings made use of a patient documentation system (1%) or mobile phones (1%) only and two other settings used virtual technology applications. In 27 (23%) of the placement settings, the students did not recognize eHealth services, even though they described, e.g., the use of mobile phones, patient care documentation and numerous other services. The identified services are classified in the following table.

Table 1. The identified eHealth services in the practical placement settings

Identified eHealth services:	Frequency (%) in 116 units.
patient/client documentation system	60 (52%)
own web sites for service users	48 (41%)
telephone consultations	46 (40%)
ePrescription	42 (36%)
e-mail in service use	29 (25%)
text messages (SMS) for patients	25 (22%)
software for laboratory services	18 (16%)
virtual TV broadcast service	9 (8%)
online education for personnel	8.8 (7%)
3G computer	6 (5%)
security wristband	5 (4%)
online service-user feedback	4 (3%)
online peer-support group for mental health patients	4 (3%)
online BDI depression survey	3 (3%)
hospital safety reporting system	3 (3%)
ambulance ordering system	2 (2%)
online audit survey	2 (2%)
subscribing system for patient food	2 (2%)
care follow-up system	1 (1%)
follow-up system for service use	1 (1%)
security wristband reader	1 (1%)

What were the main issues guiding the development of eHealth services?

In terms of the main issues guiding the development of eHealth services, the students mentioned in their essays co-operation with the public sector (N=74) and co-operation with different user-groups (N=66). They also mentioned active participation (N=32), empowering co-creation (N=23), a creative approach (N=20) and arousing a sense of empathy (N=17). The students only mentioned data co-operation with commercial companies and service design in development projects six times.

Table 2. The main issues guiding the development of eHealth services

Main issues guiding the development of eHealth services:	Frequency (%) in 116 units
co-operation with public sector	74 (64%)
co-operation with different user groups	66 (57%)
active participation	32 (28%)
empowering co-creation	23 (20%)
creative approach	20 (17%)
motivating empathy	17 (15%)
co-operation with commercial companies	6 (5%)
service design and development in projects	6 (5%)

Observations on the data from the perspective of agency

Organisation-centred viewpoint

In the qualitative analysis, eHealth services appeared merely as tools serving the interests of organisations. The students articulated the following types of objectives: developing an organisation's activities, flexibility, efficiency and speed of services and quantitative targets. Continuity of care and the flow of information from an organisational standpoint were also mentioned. The students viewed eHealth services as enablers of multi-professional co-operation in health care. They perceived eHealth services from the perspective of doing and accomplishing work. The services indirectly offer tools for the "good of the patient", but the primary objective had to do with what was "good for the organisation". When using a quantification approach, we identified issues related to both service users and providers as valuable in eHealth service design (Table 2). The quantification approach supported and broadened the qualitative interpretation of the texts.

The activities of organisations and not the needs of people were the point of focus in the data. The students pointed out that eHealth services were seen as matters of honour for an organisation. eHealth was considered as a trend or even a requirement and a challenge that cannot be ignored. eHealth seemed to be something that should be offered to visitors: eHealth facilities are evidence of the health-care industry's capacity for regeneration and of the modern way of action, which produced pleasure and feelings of pride for members of the organisation.

Individual patients were treated as outsiders, bystanders or objects

The students mentioned that eHealth services do not represent the best interests of the patient. The nurse determines the nature of the services and not the patient; the normativity of the organisation has become a point of focus. Service needs were by default defined from the organisation's point of view. This led to a passive picture of patients; the student pointed out that organisations were silencing the patients/customers. They felt that organisations make decisions on behalf of the patients and that patients are mere passive recipients of the service. They felt that the self-determination and inclusion of the clients are not important issues for the organisation. The organisations view clients merely as consumers.

Client-centred viewpoint

Prioritising the client's interest

The qualitative analysis identified the need for eHealth services to prioritise the client's interests. eHealth services should be useful for clients. Along these lines, services should be more readily available and more flexible and easier for clients to use. Also, the waiting time should be reduced. The data made explicit patients' experiences and emotions (i.e. amenities) regarding health care. The quantified data supported the conclusions of the qualitative analysis.

The students recommended using eHealth services as a way of expanding the client concept to include the whole family. This would increase the amount of choices at the client's disposal. Real-time monitoring of the process from a holistic standpoint and helping clients plan their use of time in an appropriate manner (i.e. an opportunity to be able to predict having access to care or when they would start receiving it, which would greatly reduce uncertainty and increase a sense of independence and the ability to plan one's life) would also make things easier. The students felt that eHealth services would be suitable for confirming various facts and as an information channel.

Client being involved: Client has an active influence

The students recommended using eHealth services to increase a patient's responsibility for his or her own care and follow-up. Patients would get the opportunity to become better informed about matters, to talk about their health and wellbeing, and to ask for advice related to their care. The client participation and increasing their responsibility would have a positive impact on overall client care with respect to long-term treatment (i.e. chronic and long-term diseases and diseases requiring monitoring). The positive impact would be that patients would care for themselves in a more careful manner. For example, patients would take their medication on a regular basis and more actively measure the doses and monitor their reactions.

By using eHealth services, patients would also be more active in giving feedback about their treatment and the nature of the services. Coping at home would be possible in many situations with the support of eHealth services. Discharging patients from the hospital could possibly be done more safely and at an earlier time, which would result in cost savings as well.

Together with the clients: eHealth services as enablers for two-to-one interaction

The students viewed eHealth services as offering more opportunities for clients/patients to participate in the decision-making process and to also promote their sense of agency with respect to eHealth services. eHealth services and the ways of using them can be customized and planned in such a way that they would serve the users in the best possible manner, which would give more space for patient self-determination.

Clients together as equals

Also, the idea of discussion groups, where the clients could sign themselves in and where the interaction would be between the clients themselves, was mentioned in the data. It considered peer support to be essential and also highlighted the need for coaching. When participating in this activity, the clients could create their own socially significant sense of community. Clients should be decision makers and actors. They should be able to choose the times to meet and the topics they want to share. They could also give feedback about the service and present their ideas and hopes for developing the service in the future.

Argumentation for using or not using eHealth

Doubts about how well eHealth services operate were mentioned in the data as barriers to implementing eHealth services. The safety of the system and suspicious of the reliability of the system were questioned in the data, as well. The other issue preventing the use of eHealth services was the inadequate competence of the staff and concern about incorporating novel technology into the services being offered. The data also revealed a concern about the staff being too "lazy" to learn and about it requiring too much effort on their part, as well as the fact that it might cause too much hurry and worry among them about making enough time for computers: "typing on the computer takes a lot of time". Practical issues were mentioned as well, such as a weight of the laptop when using it for home care work. In some cases, the tendency to outsource the phenomenon was explicit: "doesn't apply to us" or "we don't have the kinds of activities that would require eServices". Interestingly, the students also mentioned that eHealth services do not fit the type of work they do, since much of their work is based on interaction. In any event, they did not feel that interaction was a part of eHealth services.

In conclusion, it could be said that not only more knowledge about and instruction in eHealth services and how to use them in everyday work would be needed, but coaching in how to use novel technology at work and creating new practices for it would be needed as well. The question of management seemed to be essential, as well.

eHealth as a phenomenon and as a concept — Synthesis of the findings

Data collection during the campus visits

The campus visits (N=3) happened at Laurea during the spring of 2012. The aim was to acquire a deeper knowledge of eHealth and eHealth services in order to grasp the meaning of eHealth as a phenomenon. The participants (N= 83) were students enrolled in a health care and social welfare programme and academic staff members from three different units. The idea was to share and reflect on knowledge about eHealth and to produce new ideas for eHealth and eHealth services. The process started with a brief presentation by the Focus Area Team of Expertise in Nursing and Coping at Home at Laurea UAS. The idea continued by dividing the participants into small groups and using the workshop method. First, they wrote down all of their ideas in memos and papers. After sharing them, the different groups discussed the ideas and chose one or two ideas to further plan and develop. The plan for the chosen idea was discussed and presented during the workshop sessions. The plans were interesting.

The participation of the students and faculty members was active and creative. Also, participants became committed to coming up with and implementing new ideas during the workshop. The co-operation and ideation process yielded many ideas for co-designing virtual or digital services as a part of eHealth services. Cordner, Klein and Baiocchi (2012) used a co-designing and co-teaching workshop in their studies and noticed that the process of sharing and critiquing ideas supports reflexivity and innovative collaboration between students and teachers. At Laurea UAS, the Learning by Developing model (LbD) is a learning strategy and it is at the core of learning and teaching (Laurea, 2011). The participants made use of the LbD model when implementing the ideation process, which was congruent with the aims of the work done by the Focus Area Team of Expertise in Nursing and Coping at Home.

Data was collected in order to investigate and describe the current situation with eHealth in the field of health care and social welfare. A mixed methods approach that included both a quantitative and a qualitative component were used during the data collection process. Participants were asked to describe eHealth as a phenomenon. A data triangulation approach was applied and other rich data collection methods, such as written essays, questionnaires and group work during the idea sessions, were also used. During the process, the data were first analysed independently; then, the data was integrated and synthesised.

The synthesis of the findings is structured and presented from the perspectives of the current situation with eHealth. (The factors that both hinder and promote eHealth and eHealth as a phenomenon were conceptualised using four main concepts.) Challenges for the future were also included in the synthesis.

The current situation with eHealth shows that the efforts to promote it are anchored in Personal Electronic Health Records (PHR), eRecipe and the documentation process. The data concern eHealth and eHealth services mainly in the metropolitan areas in Finland. Digital services and the use of new technology in health care and social welfare are still in the process of being developed and there is presently a huge need for the development of eHealth services. Home care is often used as an example of a setting where eHealth has been or will be applied. The surprise in these findings is that, all in all, eHealth as a phenomenon is only being discussed quite superficially by professionals in care contexts or settings.

Students mentioned the factors hindering eHealth in health care or social welfare settings more often than those that promote it. The attitudes, prejudices, uncertainties or fears of various professionals can hamper or even block plans for using eHealth services. Also, the students mentioned a lack of competence and knowledge as hindering factors.

The factors promoting eHealth, such as a positive attitude, the courage to test and pilot new issues and methods and participation in the development process will help change the traditional way in which health care, decision making and self-care are handled via eHealth.

The conceptualisation of eHealth as a phenomenon can be demonstrated through the four main concepts that emerged in the data (Figure 1).

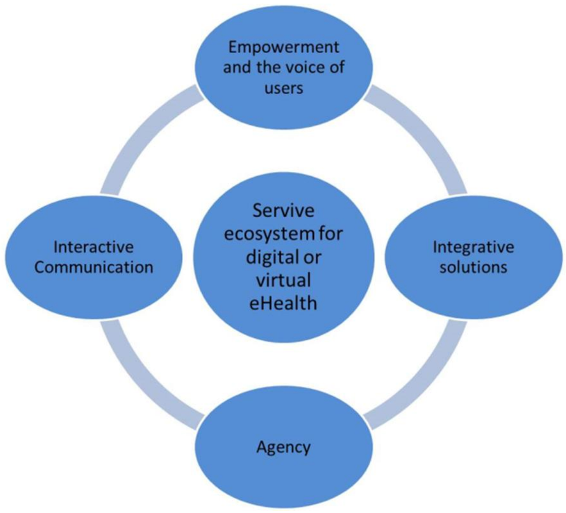

Figure 1. Synthesis of the findings

Interactive communication as a concept included both various actors' points of view and also technological advances or advice given in an eHealth context. With interactive communication, the principal actors are clients, significant others, professionals, stakeholders or entrepreneurs. Videoconferencing, Skype or other online possibilities were mentioned often as preferred methods of communication.

Digital or virtual ecosystem for services

In the ideation sessions in particular, the participants mentioned several possible or new ideas for eServices. A digital or virtual ecosystem is a broad concept that provides a framework and process whereby the contents and methods used in eServices can be planned and implemented. A co-created and constructed ecosystem makes it possible to produce new services as a whole. The ecosystem offers a systematic way to collect and integrate multidisciplinary actions via a user-driven approach and eServices.

The content factors that participants included in the eHealth service ecosystem included eServices, tailor-made services, technological solutions and ICT programmes, data security, safety and knowledge management. The service ecosystem enhances a real platform for both the public and private sectors and goes beyond the traditional sectors, such as health care, social welfare, business, ICT, education and research.

Maintaining a focus on users´ empowerment and the voice of users are of fundamental importance when developing and creating something new in a health care and social welfare context. A respect for human beings adds dignity to life and forces professionals to treat the person as a holistic being. Actors´ real involvement and active participation in the process reflect unique values and cooperation towards a more user-centred, or user-driven or client-driven, approach to the change process in health care and social welfare field.

Offering an integrative solution as a service concept connects different types of technical advice and programmes. Integrating the solutions makes it possible to plan and construct new supportive solutions and applications that promote eServices, such as online meetings, guidance, counselling, reminders, monitoring and self-care in, e.g., the home context and hospital settings.

The themes that emerged offer a framework, contents and methods for developing and transferring user-driven eHealth services during the current transitional phase of digital or virtual care. Active cooperation with clients, professionals and entrepreneurs can be deeper and more systematic in order to achieve better eHealth services. Co-creation is the key for these actions.

Conclusions regarding challenges and opportunities

The work done by the Focus Area Team had two specific objectives. On the one hand, the team supported Laurea UAS's role as an education policy actor and as an innovator of new practices. On the other hand, the objective was to recognise the new solutions developed in co-operation with partners and the co-creation process they entailed.

The definition of eHealth as a phenomenon and as a concept was based on data collected during the ideation sessions with students and staff at the Laurea UAS campuses and based on the assignments given to students in practical settings. The findings formed the basis for the definition and description of eHealth and the activities pertaining to education and research within the context of the Focus Area of Expertise of Nursing and Coping at Home.

As a result of qualitative contents analysis, the creation processes for eHealth and adapting it as a part of daily work were made visible. With the assistance of quantitative data, we tested the initial eHealth concept created as a result of nominal group decisions by the Focus Area Team. The analysis revealed the diversity of eHealth services in different practical settings. The means for organising these services and the ways in which they are applied, the attitudes among personnel, the barriers and facilitators to additional eHealth services, and the ability to implement and use eHealth services varied tremendously. Ultimately, the results of the qualitative and quantitative analysis were combined during our critical inspection of the research results. We concluded that the quality of eHealth services and equality of the service users are important issues in co-creation.

The challenge for Laurea UAS as an HEI is to continue this kind of co-creative process for designing and implementing new digital and virtual services with the clients and with the patients using the Living Lab approach. Through Laurea's Learning by Developing (LbD) model, together with the Learning Living Labs (LLL), these changes and mechanisms can be implemented in practice.

Furthermore, it is obvious that knowledge-intensive organisations can no longer rely on traditional top-down models when coping with the uncertainties of the complex global world or with the unpredictability of user behaviour. Instead, organisations have to learn to integrate the bottom-up partnership approach and open innovation models rather than top-down initiatives. With ageing populations throughout Europe, limited budgets and the "democratisation of medicine" (Topol, 2012), it is paramount for health and social sector organisations to mobilize, engage and empower their personnel and clients to develop new ways to meet the various needs related to health and social care. Similarly, companies need to mobilise their staff, clients and other stakeholders to generate new products, services and processes, and they must do this in a novel way. It is important to gain the commitment of self-organising individuals to manage their own health during their lifecycle.

Furthermore, Topol (2012) claims that a true democratisation of medical care is within reach. This vision is based on examples epitomising how future technology will dramatically improve the quality of care and reduce the cost of health care at the same time. Noar and Harrington (2012) demonstrated that eHealth helps individuals make better decisions about their health and how to live in accordance with those decisions.

We found agency to be a fruitful and meaningful concept for understanding the role of the client and the phenomenon of eHealth. It can enable a new kind of infrastructure for promoting health and wellbeing. Agency could be perceived as a capacity of an agent (a person or other entity, human or any living being in general) to act in the world. Instead of positioning clients as service users or end users, they should have active agency in the co-creation process (see, e.g., Bacchi, 2005; Davies, 1990; Ronkainen, 1999; Vehviläinen & Brunila, 2005). Empowerment (see, e.g., Cummins, 1999; Rappaport, 1984; Zimmerman, 1984) is one of the core characteristics describing the nature of agency, one that includes active involvement in the participatory development process.

It would be extremely interesting in the future to conceptualise agency within an eHealth context in a collective manner, thereby overcome the distinction between individual and collective agency (e.g. in co-creation and coaching on how to use novel eHealth services).

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About the Authors

Tarja Kantola works as a principal lecturer at Laurea UAS. Her doctoral thesis (2010) focused on work-related well-being and learning in change situations (Transcending "the impossible": From dead end to expansive learning. University of Helsinki, Department of Behavioural Sciences; https://www.doria.fi/handle/10024/61563). Her main research interests include learning, work transformation and work-related well-being as well as regional development and multi-voiced co-configuration.

Tuija Hirvikoski has a PhD in Industrial Management. Her research interests centre on Finnish education and innovation ecosystems as well as creativity and innovation. At Laurea UAS, she is responsible for the internationalisation of research and development operations and for focus area development in the fields of Service Business and eHealth. She has promoted cross-border co-operation related to user-centred and knowledge-intensive innovation ecosystems with, for example, Finnish technology centres and the European Network of Living Labs.

Paula Lehto is a principal lecturer at Laurea UAS. She completed her doctoral thesis in Health Sciences, Family Nursing Science in 2004 at Tampere University Finland. Her research interests include family health, action research, grounded theory and qualitative research. She is currently a board member of the Finnish Society of Telemedicine and eHealth.

Teija-Kaisa Aholaakko is a principal lecturer at Laurea UAS. She is PhD candidate in the Helsinki University Medical Faculty. Her research focuses on improving infection control practices in perioperative settings using quantitative and qualitative methods. She has developed greater nursing education through international co-operation with several academic consortiums. Her main interest is in developing competence-based assessments.

Maija-Leena Kukkonen works as a senior lecturer at Laurea UAS in Porvoo Unit. She has coordinated the pedagogical development of studying processes. Her interests include the development of professionalism of students, supporting and supervising students at University of Applied Sciences through LbD model.

Sanna Partamies works as a development manager at Laurea UAS in Lohja Unit. Her career in nursing consists of internal medicine, surgery and neurology ward work as both a nurse and clinical nurse. She has also written a textbook on nursing (Kliininen hoitotyö 2012). Her interests include the development of nursing and pedagogical development of studying processes.

Helsinki-Uusimaa Region, an International Innovation Concentration

Olli-Pekka Hatanpää, Uusimaa Regional Council, Finland

Abstract

Helsinki-Uusimaa Region (hereafter referred as Helsinki Region) has many well functioning innovation centres which are cooperating with neighbouring universities and industry. The cities in the region want to be in the van of development by developing and strengthening their regional and thematic innovation environments. In these environments, where businesses, research and education institutions and various development organizations are present, the cities can develop their services and support the innovation activities of other actors as well. Moreover, the cities in the metropolitan area wish to promote cooperation between the innovation environments across the municipal borders and agree on the allocation of work and recourses in the thematic development environments. The challenge is that the opportunities to boost the productivity and new innovations by interconnecting and swapping the knowledge and new findings of separate innovation hotspots are not yet fully used.

The article will discuss the achievements and challenges of the Helsinki Region in developing open innovation ecosystem. The key questions tackled are, how the political goals and commitments of the Region are in line with and implement the Europe 2020 Strategy and major European initiatives aiming to connected smart regions, as well as how the Helsinki Region is creating its way for better collaboration to harness efficiently the huge innovation potential of the area.

Keywords

Innovation ecosystem, collaborative development, smart region, CO-development, open innovation

Introduction

The Helsinki Region forms the metropolitan area in Finland. Helsinki Regional Council (officially Uusimaa Regional Council) is the regional authority for Helsinki Region. The owners of the Regional Council are the municipalities of the region. The main tasks of the Council – being a coordinator and consensus builder for the region – are regional and land-use planning, as well as the promotion of local and regional interests in general. The Regional Council articulates common regional needs, long term development goals and conditions for sustainable development. To support sustained wellbeing and economic growth in the region the Regional Council works in close cooperation with member municipalities, the government, the business sector, universities and research institutions, as well as with civic organizations.

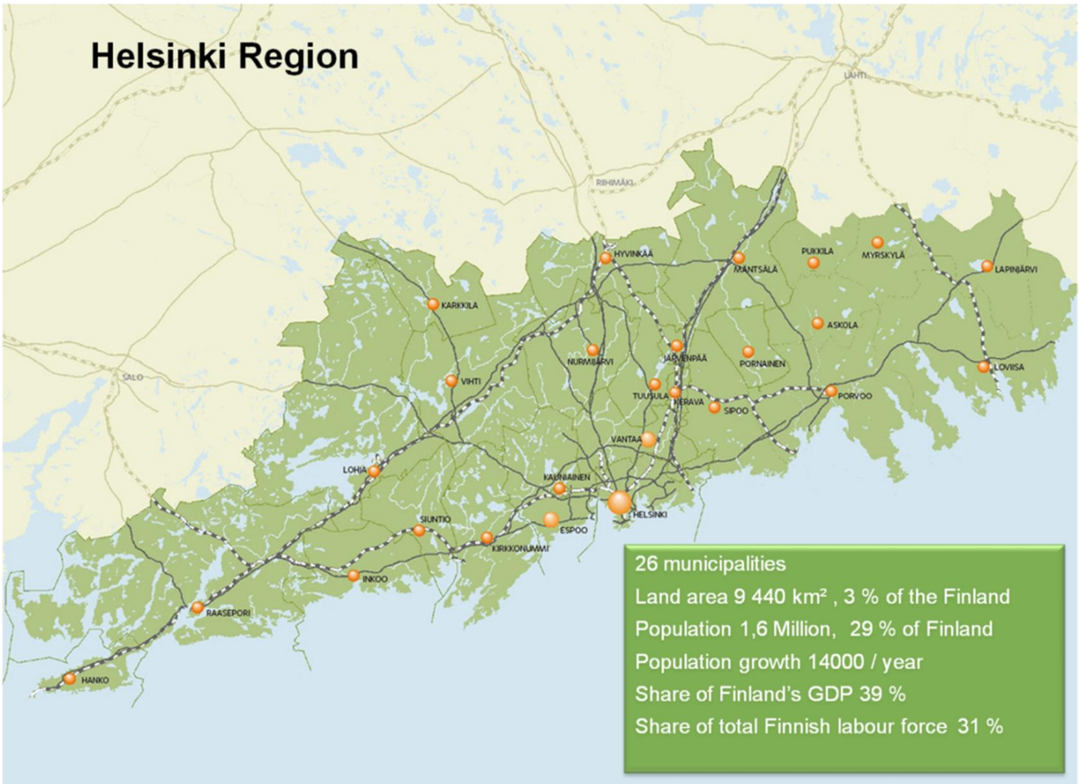

Figure 1. Helsinki Region

The Helsinki Region is the centre of Finland's economic activity. Its strengths are skilled people; a research and education environment of high international quality; and a versatile business landscape and the basis it creates for innovations. There is a concentration of small and medium-sized enterprises (SMEs) and large companies in the area – both Finnish and international ones. The region's industrial structure is extremely versatile and its population structure highly international. In fact, 55% of Finland's non-Finnish speakers reside in the Helsinki Region. The region is easily accessible both on the national and regional level. It is, nevertheless, vital to ensure and develop connections to international markets. To this end, the Helsinki Region has a fast rail link to Russia, good flight connections to Europe and Asia, and frequent maritime connections to Tallinn, Stockholm and Saint Petersburg.

The challenges that concern Finland's international competitiveness are especially relevant in this region. Maintaining and enhancing economic competitiveness requires continuous economic investment and competence development, and the Helsinki Region has good prerequisites to grow and to sustain the growth. The decisions taken in the region are vital importance for the future of entire Finland.

An important strategic development objective of the Helsinki Regional Programme is to create intelligent and sustainable growth and to secure the region's place among the leading developing areas in Europe. The successful achievement of this objective requires enhancing the region's innovation ability and regional and national innovation systems; maintaining a high-quality competence base; creating a positive atmosphere for new companies and start-ups; favouring renewable energy; and improving the services and logistics systems necessary for business.

Intelligent and sustainable growth requires the utilisation of the region's full potential and particular attention to its three largest innovation hubs. Internationally significant investments that focus on Espoo, Helsinki and Vantaa provide an excellent base for growth and innovations. With the right measures and policies, the entire Helsinki Region will be able to reap the benefits.

The core of the Helsinki Regional Programme is crystallized in the vision"2040 Helsinki Region - Leading position in the Baltic Sea Region" The political vision of the region is the idea that a strong capital area serves as an engine securing prerequisites for the success of whole of Finland. The region is being developed as a growing metropolis by paying particular attention to expertise, innovation and well-functioning local structures. The Programme is the product of an extensive consultation process involving all major stakeholders in the region and in state administration. The new Programme also demonstrates political commitment, since it is approved by the Regional Council, which consists of the representatives of all 26 municipalities of the region representing over 1,5 million inhabitants.

Achievements and challenges

Finland and metropolitan area have past years been scored very high in many innovation and competitiveness indexes. Harvard Business Review ranked March 2009 Finland's innovation ability second in the world. In the Global Innovation Index Finland was 2008 ranked third. Recent rankings have not been at that high level. Finland has not actively enough implemented it's the key proposals created through the National Innovation System. R&D policy and business life have not taken seriously the signals showing the need for operational renewal. To certain extent the influences to some of our rankings have been due to success and downfall of the Nokia Phones.

But it is not only because of Nokia. The cities in the Helsinki Region have for a long time already enhanced regions compatibility by developing and strengthening their regional and thematic innovation environments. In these environments, where businesses, research and education institutions and various development organisations are present, the cities can develop their services and support the innovation activities of other actors as well.

Centre of Expertise Programme (OSKE)

One of the success stories that gave good base for development of regional innovation ecosystem has been the national Centre of Expertise Programme (OSKE), a fixed term special government programme from 1994 to 2013 aimed at focussing regional resources and activities on development areas of key national importance. The programme promoted the utilisation of the highest international standard of knowledge and expertise that exists in the different regions. The operations model of the programme was reformed for the term 2007–2013 as a cluster-based model, the overriding objective of which is to increase regional specialisation and to strengthen cooperation between centres of expertise. The National Programme involved 13 national Clusters of Expertise and 21 regional Centres of Expertise. Pivotal cooperation parties were companies, universities, institutes of higher education, research institutes, technology centres and various sources of finance (cities, municipalities, regional councils, Employment and Economic Development Centres, especially their technology divisions and county administration boards).
(http://www.oske.net/en/oske/)

Culminatum Innovation was established in 1995 to implement the Helsinki Region Centre of Expertise Programme. The company has been implementing the Living Business, Tourism and Experience Management, Health and Well-being, HealthBIO, Nanotechnology, Ubiquitous Computing and Digibusiness centres of expertise in the Helsinki Region and administered the Food Development and Cleantech centres of expertise in the Helsinki Region, implemented by its partners. Culminatum Innovation also has teams specialising in the Competitiveness and innovation development of the Helsinki Region, innovative public procurement and Public service design. Culminatum Innovation Oy Ltd is a development company owned by the Regional Council, the Cities of Helsinki, Espoo and Vantaa, and universities, research institutions and businesses operating in the Helsinki Region. When the national Centre of Expertise Programme is ending, Culminatum Innovation, established to implement the Helsinki Region Centre of Expertise Programme, will also discontinue its operations in its present form in the end of June 2014. The Regional Council and the different cities in the region are considering new approaches and structures with an eye on the EU's future programme period starting in 2014.

User-driven innovation environments

Living Labs in Helsinki Region are means for building the future innovation environment in which real-life user-driven research and innovation will be a normal co-creation technique for new products, services and social infrastructure. A Living Lab takes advantage of pools of creative talent, socio-cultural diversity, and the unpredictability of inventiveness and imagination of end-users.

In The Competitiveness Strategy for the Metropolitan Area (2009) were identified three forerunner actors in regional thematic innovation environments in Helsinki Region:

Forum Virium Helsinki is a business-based and – driven cluster of actors whose mission is to promote the development of digital services. It is also test bed for ideas and actors, collecting large companies and growth companies, leading development projects and opening connections to international markets.

Active Life Village Oy is a unique centre of well-being expertise aiming to promote the set-up and commercialisation of competitive well-being service innovations together with the people who use them. The non-profit Active Life Village provides companies with business support in addition to development activities and an inspiring environment.

RFID Lab Finland and Anturikeskus Sensor Center Oy is connected to the Vantaa Innovation Institute, which became operative on 1 May 2009. It aims to promote the internationalisation of businesses and the creation of innovation environments, among others. RFID Lab provides neutral information, expertise and services related to RFID technology and its application, especially in the application fields of logistics and asset management. Anturikeskus provides product services related to sensor systems and the laboratory infrastructure to businesses engaged in this sector. The Center functions as a springboard for start-up companies engaged in sensor technology.

In addition to these regional thematic innovation environments living labs have been established in and around Helsinki Region (e.g. Helsinki Living Lab, Arabianranta Living Lab, as well as several living labs operating around the educational institutions, i.e. Aalto, Laurea etc.) actively supported by local and regional government, as well as by governmental funding for research, development and innovation projects. Their functions are diverse, but all based on the principles of User Driven Innovation. Several Universities of applied science conduct research in Living Labs at the edge of science and practice. Companies such as Nokia, Kone and Philips, use Living Labs as user-centred hubs for idea creation and product development, and national research institutions use Living Labs as platforms for innovation. These living labs focus on bringing users – with their knowledge, ideas, and experiences – together with the developers of new services and products to increase the quality and usability of the services and products created. Collaboration with local small and medium sized companies is actively sought and managed, while entrepreneurship is enhanced at service, media and design 'Factories' through the collaboration models at Aalto University. (Helsinki Smart Region paper)

Since 2007, a network of "Living Labs" has been providing test and experimentation environments where user communities can work with producers to co-create innovative smart city services in the Helsinki Metropolitan Area. A number of successful trials and commercial projects, such as a traffic information platform and Helsinki Region Infoshare, have been deployed in Helsinki, to run open data competitions, such as Apps4Finland, to inspire start-ups, citizens and established companies to utilise open data resources. This network is overseen by Forum Virium Helsinki. (Helsinki Smart Region paper)

Helsinki Region has several innovation hotspots, specific areas and connecting actors with close linkages to Helsinki University, Aalto University and universities of applied sciences of the region.

Helsinki City Centre and the Central Campus in the historical centre of Helsinki, is the administrative hub and the largest centre of the faculties of the University of Helsinki. Similarly, the university library, the National Library of Finland, the new learning centre Aleksandria and Helsinki Think Company are situated in the city centre. Helsinki Think Company is a network and meeting place for new kind of entrepreneurship and learning in the middle of the city for students, researchers, teachers, partners and enthusiasts. Think Co. is a platform for creating action and business out of ideas steaming from the university. (http://blogs.helsinki.fi/helsinkithinkcompany/welcome/)

In Helsinki Meilahti Biomedicum Helsinki is the centre for medical research and training. It is a leading environment that promotes medical research and training in Finland and supports cooperation between academia and industry. Future challenges in health care are met with the uniquely extensive cooperation between the university's basic biomedical research and the clinical research conducted by Helsinki University Central Hospital, as well as interaction with society at large. (http://www.biomedicum.fi/index.php?page=108&lang=2)

The Viikki Campus of the University of Helsinki is an important concentration in the field of biosciences, and it is often called the "green campus". Helsinki Business and Science Park (HBSP) In the Viikki Campus has provided a dynamic business environment with a diversified research and expert network and a Centre of Expertise within biotechnology, drug development and diagnostics, as well as food and environmental technology. Their objective is to improve the success opportunities of Finnish companies on the international market, and to improve domestic competitiveness. (http://www.helsinki.fi/viikki/english/)

The Espoo district of Otaniemi, Keilaniemi and Tapiola is Northern Europe's largest innovation hub. The area and its lively activities are well described by the name innovation garden. It also respects the cultural heritage, Tapiola's values as a garden city. The area develops by the T3 initiative, which was launched by the City in 2010. T3 derives from the Finnish words for science (tiede), art (taide) and the economy (talous). The City of Espoo has applied with the T3 initiative to the iCapital award, which is organized for the first time by the European Commission. Thereby it aims to the honorary title of European Capital of Innovation. (http://www.espoo.fi/en-US/Jobs_and_enterprise/T3__Innovation_Garden)

Within this Espoo Innovation Garden Urban Mill is an emerging, global thematic focal point for Urban Innovations. Urban Mill has 1300 m2 co-working and co-creation space linked right to the Aalto University Design Factory and the Startup Sauna in Otaniemi. Together these three spaces will act as a physical and social Knowledge Triangle test-bed for the Otaniemi campus and for the whole T3 area. (http://urbanmill.org/english/)

Vantaa develops the Aviapolis area as an airport city rising around the Airport. It is a business and residential centre covering 42 square kilometres. Of Finland's total passenger air traffic, 98 per cent go via the airport and Aviapolis. The fast growing centre already has over 35,000 jobs. The Aviapolis area is important area of development and innovation in the vicinity of the international airport. A central location and great connections mean an attractive business environment. The Vantaa Innovation Institute is working for the development of Vantaa and the Aviapolis area into an international business centre. (http://aviapolis.fi/en/hub)

Laurea University of Applied Sciences, with campuses many parts of the region, has a continuous nine-year tenure as a Centre of Excellence as appointed by the National Evaluation Council due to its operative model (Learning by Developing, LbD) that integrates RDI with learning and regional development. The LbD model in conjunction with the LivingLab approach is based on innovation co-creation among various stakeholders within the Helsinki Metropolitan area and on an international level (Raij, K. & Niinistö-Sivuranta, S. (Eds.) 2011; Kantola & Hirvikoski 2012). It provides Laurea graduates with great employment and start-up opportunities. Moreover, due to this successful strategic choice, Laurea has a central role in orchestrating national and international RDI operations aiming at joint value creation in the metropolitan area (Pirinen, R., 2012 and 2013, Aho-Laakko;, Hirvikoski 2012). By creating an economically sustainable platform for interaction and knowledge dissemination based on industry-academia partnerships and by integrating the open innovation related RDI operations and educational programmes it has been Laurea's aim to educate multi-disciplinary, visionary practitioners, capable for the convergence of open innovation and technology enhanced development in the field of social and health care.

Other regionally significant innovation centres include the Technology Center Techvilla in Hyvinkää, NOVAGO in Western Uusimaa, HighTechCenter in Kirkkonummi, and the competence and STOK - Electrical building services centre as well as the cleantech innovation environments of the Kilpilahti area in Porvoo.

Helsinki Region and International Collaboration

According to Europe 2020 strategy, regions should be connected, and be part of connected innovation ecosystems. Helsinki Region is already exploring such collaborative forms of innovation practice. One potentially powerful example of this kind of collaboration is the link between the regions Helsinki – Skåne – Amsterdam, which will be further developed for European pioneering in order to create ground-breaking societal innovations for Europe-wide use. This collaboration originated as part of the 2012 Aalto Societal Innovation Camp (ACSI), an innovative international programme co-initiated by Aalto University and the New Club of Paris. The three regions worked together to explore diverse practical aspects of the question 'How can we create an inclusive and fully accessible society, in which all citizens can contribute to co-creating quality of life?' (Helsinki Smart Region paper)

Promising approaches to address issues like how to make innovativeness the common state of mind in pioneering innovation city hubs, what is needed to create societal innovation test beds, how to demonstrate innovations in both real-life and virtual reality, and the importance of the on-going ICT Cluster revolution as an accelerator for job creation and growth were developed. Insights into the new kinds of collaboration required to realize this – reciprocal relationships and relevant roles for government and civil society – were exchanged, and are being further explored in the continuing collaboration between Helsinki, Skåne, and Amsterdam regions. The initial collaboration at ACSI can lead to the effective exchange and promising solutions between the three regions and – in the context of EU2020 and Innovation Union initiatives – to opportunities for piloting new European partnership experiments and broader interregional innovation initiatives in the future. (Helsinki Smart Region paper)

The Aalto Societal Innovation Camp, which was held in Skåne in 2013, continued to pioneer new approaches to tackling societal challenges, and will link the Helsinki Region to relevant potential partners in smart regions across Europe and around the world. Helsinki Region presented there a challenge how different innovation concentrations – their activity could better support each other. The key question was defined how the region can consolidate collaborative innovation infrastructure, and create a "Virtual House of Uusimaa Hotspots".

There has been several bottom-up activities, such as the Vanguard Group (Catalonia, Friesland, Flanders, and Helsinki) initiative, in developing a strategic approach to establish collaboration and to define and implement regional smart specialisation strategies. These aim to pro-actively complement competences of regional advantages across different borders. The cooperation focuses on co-creatively developing and proposing joint programmes (such as the Regions of Knowledge proposal for the EU 7th framework program), in order to exchange talent, best practice and to commercialise research discoveries. (Helsinki Smart Region paper)

Estonia and Finland have centuries of collaboration, mainly between the capital areas of Tallinn and Helsinki that currently account for 2 million inhabitants and USD 76 billion in economic output. The entry of Estonia into the European Union and, since the mid-2000s, a two-hour ferry trip, have both facilitated flows of people and merchandise across the Gulf of Finland. The different levels of development between Helsinki and Tallinn result in many asymmetric flows (workers to Helsinki, tourists to Tallinn). Beyond infrastructure and labour market issues, there are interesting opportunities for joint innovation policy efforts given their shared strengths such as in ICT, a dynamic start-up environment and technologically sophisticated public services. Cross-border collaboration can help build an "entrepreneurial knowledge region" brand. (Nauwelaers, C., K. Maguire and G. Ajmone Marsan (2013))

Global competition between city regions over talented people, thriving businesses and international investments is tightening. The Helsinki Metropolitan Area has ranked well in a number of international competitiveness comparisons, but staying on top requires continuous, sustained development and actions. There are some prerequisites that are hard to change, like the size of the market, but most of them are in our own hands. The challenge is that the opportunities to boost the productivity and new innovations by interconnecting and swapping the knowledge and new findings of separate innovation hotspots are not used enough.

Smart Specialisation as the Framework for Strategic Choices

The European Commission has actively highlighted the regional design of research and innovation strategies for smart specialisation (RIS3) in the preparation for the 2014–2020 programming period. The Finnish Ministry of Employment and Economic Development has also emphasised the importance of smart specialisation for growth, and instructed the Finnish regions to use these strategies in the preparation of their regional programmes.

Smart specialisation is a strategic approach to economic growth, which uses carefully targeted R&D investments. RIS3 is above all a process characterised being an economic transformation agenda. On the regional level, the objective of smart specialisation is to utilise the region's competence potential. This requires creating a vision, identifying competitive advantages, and making strategic choices.

The Helsinki Regional Programme is based on the choices and solutions of the entire region and its individual areas, which have been presented for example in the Helsinki region competitiveness strategy, Open Cities programme, growth agreements of towns and cities, and the preparation documents of the Innovative Cities Programme.

Political goals and commitments

Political commitment of Finland to enhance compatibility of the cities and regions is very well described in Innovative Cities programme (INKA) of The Ministry of Employment and the Economy. The objective of the Innovative Cities programme (INKA) is to support the creation in Finland of internationally attractive innovation clusters. The programme challenges urban regions to create new types of business development environments and trailblazing markets based on expertise. The programme will be launched in 2014 and will be managed by Tekes. Through the INKA programme, the synergy of national and regional innovation policy activities will be given support. The purpose is that the urban regions and the State will together accelerate the achievement of new types of large project entities that also enjoy international visibility. In the future, the cities are expected to use their land use, residential and traffic infrastructure projects as development and testing environments for innovations. The programme will supplement other pivotal innovation policy instruments – such as Tekes programmes and Strategic Centres for Science, Technology and Innovation (SHOKs). The INKA programme will replace the Centre of Expertise programme (OSKE), which ended in 2013.
(http://www.tem.fi/en/innovations/strategic_centres_and_clusters/innovative_cities_programme_(inka)

The Helsinki Regional Programme

The key components of the EU 2020 Growth Strategy form a starting point for the Helsinki Regional Programme. According to the strategy, the goal is to create more intelligent growth (by making more efficient investments in education, research and innovation), more sustainable growth (by moving towards a carbon neutral economy and by strengthening the competitiveness of industry) and more inclusive growth (by making major contributions to create jobs and reduce poverty).

The government steers regional development work especially through its national land use and development goals as well as through revised regional development legislation. The development goals set by the government for regional administration were taken into account when drawing up the Helsinki Regional Programme.

Special emphasis was placed on regional and municipal strategies, programmes and agreements. The strategies of the member municipalities, the competence strategy for the metropolitan area (Elinvoimainen metropoli) and the growth agreements between the government and the municipalities are also observed in the Helsinki Regional Programme.

The EU's financial programmes and national financial instruments are used more efficiently in the Helsinki Regional Programme than before, and their use is targeted in a comprehensive fashion in order to implement the joint objectives of the programmes.

Vision and strategy of Helsinki Region

Joint vision 2040 for the cities and municipalities of Helsinki Region stated in Uusimaa-programme is "Helsinki – On top of the Baltic Sea Region". The strength of the Helsinki Region is reflected by its choices. The region is already a strong player in Finland, but it can only be strong in a global context if it can make the right strategic priorities that will lead to growth and development. A realistic view of the regional context will lead to the best results.

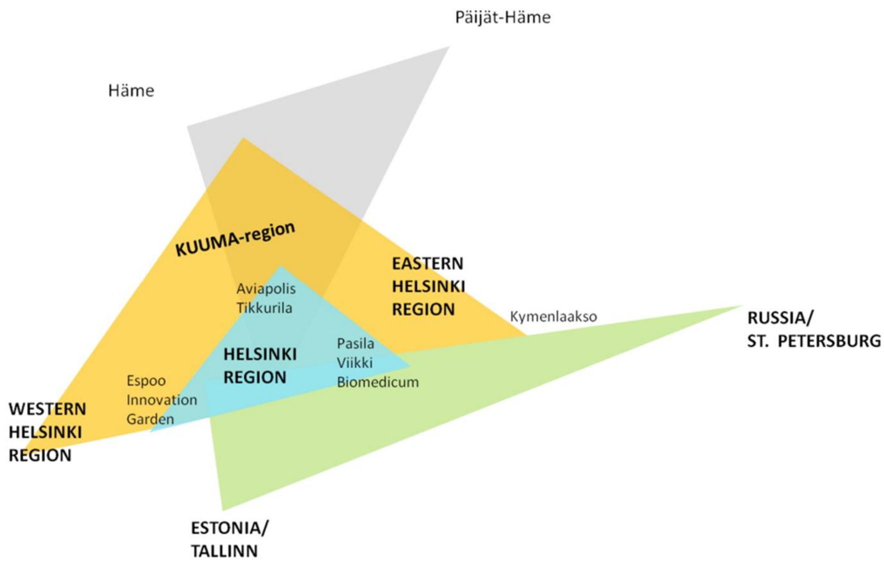

Figure 2. Triangles of Growth and Collaboration of Helsinki Region (Helsinki Regional Programme)

The spearhead triangle entails substantial development projects in the cities of Helsinki, Espoo and Vantaa. Helsinki is building development and innovation clusters in Meilahti, Viikki, Kumpula and Pasila. Espoo has the ambitious target of making future investments in the T3 area – Espoo Innovation Garden, which will become an internationally important hub for technological development and innovations. The future strength of Vantaa is based on its airport area, Aviapolis, which will be developed as a hub for logistics, employment and housing. The spearhead triangle is an engine that drives economic growth and functional development in other areas of the region as well; the biggest investments by far are made in this area.

The growth triangle consists of the eastern, central and western parts of Uusimaa. Each part of the growth triangle has its own strengths through which it can take advantage of the growth in the metropolitan area. In the Eastern Uusimaa Region, the strengths are a strong energy sector, tourism, and the proximity to Russia. The Northern Growth Corridor links East and West to each other and to the spearhead triangle. The growth corridor spans all the way from Saint Petersburg, Helsinki and Turku to Stockholm.

The development triangle describes the metropolitan region in its widest sense up to Hämeenlinna and Lahti, as well as the dynamics of the metropolitan mindset.

The future triangle consists of the regions around the cities of Tallinn, Helsinki and Saint Petersburg. The growth of Uusimaa and the entire country is constrained by the small size of its internal market. We must therefore extend the Finnish market to cover the whole Gulf of Finland area. Uusimaa and Tallinn already function as a fairly well-united employment and trade area. The challenge in the coming years is to expand this twin city and turn it into a triplet city so that Saint Petersburg and its surrounding area will be more tightly linked to the triangle. This requires closer functional collaboration and a denser infrastructure with Saint Petersburg and its surrounding area.

Strategic priorities of Helsinki Region

The strategic priorities of the 2014–2017 Helsinki Regional Programme are: Opportunities for Growth, Working Everyday Life, and Sustainable Ecology. These choices are based on the premises presented in the vision and strategy of the Helsinki Regional Programme, and on the special characteristics and opportunities of region. The choices are geared towards a balanced development of the different areas in the region. The municipalities' development objectives are also a part of the foundation of the Helsinki Regional Programme: the work is based on an analysis of municipalities' strategic development objectives and priorities. From the programme implementation perspective, the choices focus on the division of labour between various EU funding instruments and national funding, and to the utilisation of different funding programmes.

Political commitment of Helsinki Region to implement European 2020 policies and initiatives aiming to connected smart regions is crystallised in the strategic choice of Opportunities for Growth:

The Helsinki Region is the most important hub of economic activity and population in Finland. The strengths of the metropolitan area are a versatile business landscape and an educational environment that is of international high quality, both of which lay a firm foundation for innovations. The region's competitive advantage comes from high competence, services and product development. The focus of development in industrial and commercial activity lies in knowledge-intensive fields. To this end, universities and universities of applied sciences play a crucial role as the trainers of future experts. They create the preconditions for innovations and for the development of working life and the operations of businesses and organisations.

Increasing collaboration between municipalities is needed in order for the metropolitan area to function as a 'smart region' and for the strengths of the different areas in the region to be fully utilised. A smartly specialising metropolitan area makes use of the opportunities that information technology, open data, participation and new innovation platforms (real life development environments) provide for services and business. The Helsinki Region is the most well-equipped region in Finland to utilise creative economy and creative competence. For example, both media and gaming industries are new, rapidly growing industries that operate directly in international markets.

The greatest opportunity for new growth in the Helsinki Region is brought about by the move to a global digital economy. Digital services are the most steeply growing area of business in the world. Almost half of the world's population – up to three billion people – will be online by the year 2016. The impact of intelligent digital services and the Internet also extends to traditional livelihoods across geographical borders. The Helsinki Region is well prepared to make use of this international opportunity. The development and application of ICT requires constant attention because the industry is undergoing significant changes and is a growth enabler for most industries.

The Helsinki Region is the strongest entrepreneurial area in Finland. Even so, it needs new, young entrepreneurs. Nurturing an atmosphere that is conducive to entrepreneurism and integrating entrepreneurship education at different levels of education promote the development of an entrepreneurial culture. The Helsinki Region needs many kinds of entrepreneurs: existing businesses need new hands on deck in their succession, and the region needs more start-ups and companies driven towards exports. Immigrants are also often potential new entrepreneurs.

Open Development Environments and Intelligent Services

The strengths of innovation activity in the Helsinki Region stem from a user-driven and open operational model that is based on real-life development environments, which can, for their part, actively support both local and international R&D projects. The model brings together collaboration between universities, universities of applied sciences, municipalities, and SMEs.

The development work is conducted not only in the large centres of the spearhead triangle of Helsinki, Espoo and Vantaa and the growth triangle of the surrounding region but also in projects related to everyday work and in premises where new innovations are tested in everyday conditions. Open development environments provide a platform for experiments, successes and failures, and everything else required by effective innovation activities.

Opening GIS data, maps and other information sources enables the development of municipalities' services for example in construction, public transport, waste management, energy distribution and the well-being sector. The harmonisation of open data also increases new business opportunities.

Objective of the Helsinki Region is to be an international centre of innovations and a pioneer in the deployment of innovative products and services.

Measures to achieve this will be:

- Support business and innovation through urban planning.
- Support actions to remodel and network the Helsinki Region's innovation structure.
- Promote the development of new service solutions by utilising open data and societal and social innovations.
- Create pioneering markets for high competence products and SME services.
- Add intelligence to public transport services and systems (digital services, etc.).
- Support actions to raise the universities in the region among top universities in the world.

Conclusions

Helsinki Region has a successful history in developing and utilising its innovation ecosystem. It is one of the top ranked regions in the word. But the global competition is hard. When you wish to be a forerunner, you have to keep running faster than others or at least as fast. The political goals and commitments of the Helsinki Region are of high standard with respect to European 2020 policies and initiatives aiming to connected smart regions. To be an attractive partner to other smart regions in Europe, the local and regional authorities have to create favourable conditions for collaboration of all key R&D actors, including industry and citizen engagement in the innovation activities. The other key requirement is enabling successful co-creation of high level products, services and systems as the outcomes of the smart innovation spearheads.

As stated in the working paper for the EU Committee of the Regions EDUC Conference April 2013 "Helsinki Smart Region: Pioneering for Europe 2020" collaboration is of crucial interest. The first innovation strategy for the Helsinki Region and also new ones show the way forward for collaboration that will more efficiently harness the huge innovation potential of the metropolitan area. The future competitive strength of the Helsinki Region and its appeal as a strategic partner for the world's other leading knowledge hubs will depend on the region's record of effective collaboration. In terms of Porter's concept of cluster, Helsinki Region forms a strong innovation oriented cluster around mobile technology, based on favourable factor determinants such as high quality research and education institutes, a continuous demand for change and innovative services, a highly competitive business environment, and at the same time strong innovation-driven networks of businesses and with governmental actors.

The challenge is how we can create the environment and facilities for knowledge sharing, more open discussion, intersectoral innovation co-operation that individual innovation actors can get benefit from. The Region is building the ecosystem that can lead to greater break-away improvements through multidisciplinary experimentation and co-creation of innovative interdisciplinary start-ups. First steps to take are deepen the objective "to be an international centre of innovations and a pioneer in the deployment of innovative products and services" by drawing up during the Spring 2014 the RIS3, i.e. Smart Specialisation Strategy, for the Region in collaboration with the broad scale of innovation actors, both regionally and internationally.

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About the Authors

Olli Pekka Hatanpää is planning manager in Uusimaa Regional Council. Recent years his main focuses have been in foresight work, regional development, housing, international co-operation and benchmarking. He has also taken part in the work of many centers of expertise of Helsinki Region as a contact person of the funder.
Education: Master of Science in technology (Surveying and urban planning)

Espoo is a Smart City through Collaboration

Kristiina Erkkilä, City of Espoo, Finland

Abstract

The article discusses the change in collaborative practices between the City of Espoo and its partners, particularly the educational institutions around it, in order to act smarter. The goal to reach closer collaboration requires the city to open up its processes and data as much as possible. This is a challenge for education institutions to change as well. In addition, since the universities have been identified as drivers in their ecosystems, even more renewal is needed from them. The city can benefit a great deal from being an active member in these university led ecosystems. A smart city seizes a lot of opportunities in being the orchestrator in the collaboration with educational institutions. A smart orchestration is the most effective way to lead complex networks and ecosystems.

Keywords

collaboration, open data, city-education institution relationship, ecosystem, smart orchestration

Collaboration gives added Value

The City of Espoo used to have a slogan for marketing purposes: Espoo is the Capital of Knowledge. That was based among other things on the fact that the population of the city has the highest educational level in the country and that the city's economy was based on knowledge intensive industries. The facts are still there, but the city does not use that slogan anymore.

A few years back organizations bragged about how much knowledge and competences they have in-house. Smart organizations today brag about how much they use knowledge and competences and most of all smart solutions from outside. This is where the City of Espoo has needed to make a major change in its practices and in how accessible the information in the city is.

The starting point of this article is that one of the key elements of a smart city is the potential of collaboration and the elements that make it work. A city can benefit a great deal of improved collaboration either within the city or with its outside partners compared to the traditional way of conducting service development mainly as its own work. The article studies the case of the City of Espoo. At first, the role and tasks of a city as a local authority in Finland, is explained. Then the change in the strategy documentation, processes and practices of Espoo are discussed. It also studies the input from the EU-decisions to the local level implementation. The article suggests opportunities that open up through the added collaboration particularly with educational institutions. The article is in many ways relating to the professional experience of the writer's ten years of employment with the city.

Role of a City in Finland

In Finland, local authorities, i.e. cities and other municipalities, have a broad responsibility for the provision of basic services for their residents. Most important services relate to social welfare; health care, education and culture, the environment and technical infrastructure. Local authorities have strong self-government based on local democracy and decision making, and the right to levy taxes. Studies show that residents value municipal services and like to use them. Finnish local authorities are continuously improving their services and seek to ensure performance and efficiency. Several municipal services can already be accessed over the internet and more online services are becoming available.

Local authorities often set up a joint municipal authority to establish co-operation on a more permanent basis. Joint authorities typically provide educational and social and health-care services. Several local authorities can for example together establish a joint vocational institution.

See more Association of Finnish Local and Regional Authorities.

From traditional Espoo Strategy to Espoo Story

Espoo is committed to be among the prime movers. First of all its task is to serve the residents of the city. The citizens of Espoo have the best educational level in the country and are therefore demanding customers. Also, as Espoo is one of the fastest growing cities it faces many challenges among the first in Finland. Therefore the pressure for development work in Espoo is strong. The city is striving hard to be a smart city that is recognized of being a forerunner among cities both nationally and internationally.

The city changed its strategy process and documentation in year 2013. In the past the strategy document was many pages long and written by civil servants with complicated concepts and language. Now it was decided early on to change the strategy to an easier and more citizen friendly story format. Ideas and materials for the strategy were collected from the citizens with many different ways. A web based collaboration tool was used to incorporate online crowdsourcing. The site was open for four months and the process included also peer review and dialogue. The Mayor visited different areas of the city and met with citizens in resident events. Pre-school children got to propose what they would do if they would have a change to be one day as the Mayor of the City. During Annual Espoo Day workshops were given to young people and adults separately. Approximately 15.000 ideas were received. These were then comprised to a story by several workshops with the City Council and with several working groups.

The Espoo Story portrays the history, presence and future of Espoo i.e. the strategy in a nutshell. It also identifies city's greatest challenges. These challenges are addressed in all city activities across services and will be implemented in development projects in collaboration within the city but also with citizens, companies and other partner organizations. A great challenge already is to break the silos within the city organization. Each development program has a team of leading politicians and civil servants to work together and across borders and to initiate ideas for prototyping or projects. The development programs deal with topics in citizen participation, youth activities, vitality of the elderly, sustainable development and competitiveness, innovativeness and entrepreneurship.

See more City of Espoo/Espoo Story.

City invites others to contribute

The public sector can encourage and inspire the development of totally new or improved services. A municipality can explore the benefits of employing its extended network in value creation. This enables to outsource certain tasks to valued partners and allows the city to focus on its essential tasks not to mention to gain knowledge and competence of others. The city can for example with its procurement advance the implementation of new innovations that meet the needs of its residents and this way steer the markets to the direction that is beneficial for public services.

The City of Espoo encourages its partners, enterprises and other communities to participate in developing new solutions for the challenges that the city faces. The goal is to provide win-win situations so that the adopted new services or tools can be substantial references for the developers and that way improve their competitiveness in their own market areas. The new solutions should be need based and user friendly and they should increase economic, social and ecological sustainability. They are also expected to build on high competence and to benefit from the use of technology.

Opening up Data and Processes

The City of Espoo has decided to open up its processes and data as much as possible to enable interested parties to participate in the development of city services. A good accelerator has been Helsinki Region Infoshare -project that aimed to make regional information quickly and easily accessible to all. The project was a joint effort with neighboring cities. The data published is mainly statistical, giving a comprehensive and diverse outlook on different urban phenomena, such as living conditions, economics and well-being, employment and transport. A good proportion of the data material offered is GIS based. The data may be used by citizens, businesses, universities, academies, research facilities or municipal administration. The data is ready to be used freely at no cost. Users can download information and use it in decision making, utilize it in their own applications, or develop entirely new services based on the information. Users of the service can also submit feedback and participate in discussions on the data pools and submit requests to publish new materials as open data. The project ended in 2013 and after that opening data and continuing operating the web service became part of municipalities' ordinary operations. See more Helsinki Region Infoshare.

In addition, the City of Espoo is opening up its own processes and data so that citizens and enterprises can be involved in city's development work or even find opportunities for their own purposes or businesses. Two new services were recently awarded in the Mayor's Innovation Competition, where new innovative ideas created by the city employees were given recognition in year 2013 for the second time. The first awarded service is Energy Information System, EIS, which is a web based service for the residents of the City of Espoo considering making use of renewable energy sources, such as solar energy and geothermal heat. EIS is based on solar energy analysis created by laser scanning combined with the weather data of the Meteorological Institute; as well as geothermal analysis combined with a soil map of the City of Espoo, soil and bedrock data of the Geological Survey of Finland as well as the map data of the National Land Survey of Finland. All these data sources are as well open for everybody to use. EIS is currently available only in Finnish, but can be in the near future translated in to other languages. The second winner in the Mayor's Innovation Competition was Regional Reporting Application. The application combines data of defined key performance indicators from several data sources in the area urban planning and construction activity. Regional Reporting application is the first open business intelligence tool in Finland to enable efficient service development and urban planning.

In the field of public procurement the city is currently developing ways to open up processes to enable enterprises bring solutions for the city's service needs. This way the city could benefit from private sector innovation potential.

Educational Institutions as Development Partners

By clearer identification of the city's wicked problems it is easier to communicate the challenges to others and to get them involved in finding better solutions. By inviting others to join in co-creation and opening up data and processes a smart city can gain collaboration opportunities with its even smarter partners. The City of Espoo has realized that there is a lot of potential in the wide network of secondary and tertiary level educational institutions that are in partnership with the city. In many cases Espoo is one of founding bodies or funders of these institutions. Some of them are joint municipal authorities or similar. When Espoo has a role in the institution it is easier to start collaboration and to find mutual interests.

In the past the connection between an institution and the city was only between the two organizations and sometimes it was rather formal. Then the city started to invite the leadership of the educational institutions to meet the city representatives in once a year meetings with both formal and informal things on the agenda. Today there is a network and an active collaboration between the leaders of the city and the leaders of educational institutions. This network meets several times a year to discuss current mutual topics and to share concerns. In addition, several workshops have been held to find solutions for the challenges of the city. Majority of the educational institutions involved are those that have a special bond with the city, but also others, who find it interesting and beneficial for their own operation, have joined the network (see Figure 1).

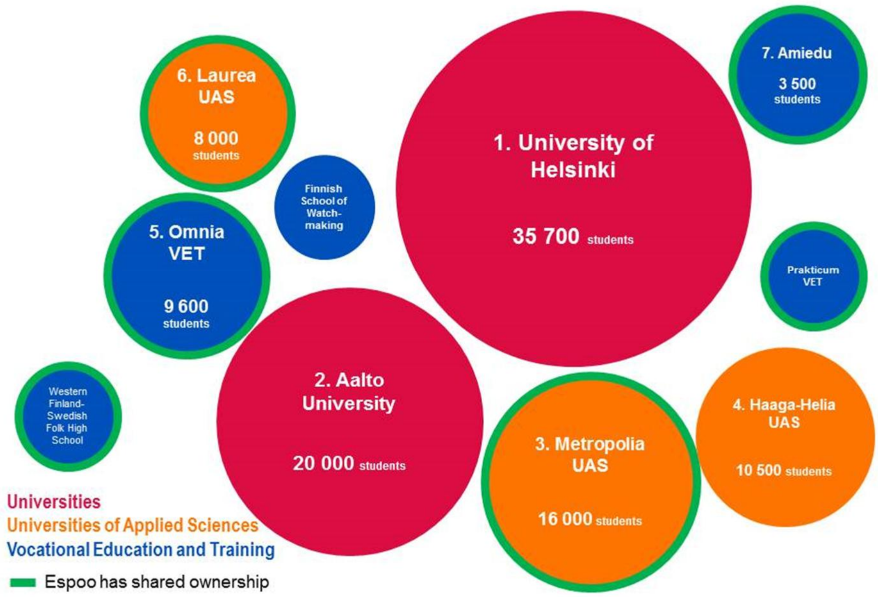

Figure 1. Espoo Education Partnership Network

Finnish Universities are independent from local authorities, but some of them have joined Espoo Education Partnership Network. For example Aalto University was recently merged of three top level universities (arts, business and technology) and it is one of the internationally best recognized universities in Finland. Aalto has its main campus in Espoo and it has claimed that the City of Espoo is one of its strategic partners and vice versa. Aalto University wants to collaborate with Espoo in multiple levels and ways.

InnoEspoo

To ensure, that the collaboration is active on many levels, not just among institutions' leaders, the City of Espoo and partnering educational organizations put together a project called InnoEspoo. Students, teachers, entrepreneurs and local decision makers form InnoEspoo community for sustainable entrepreneurship. InnoEspoo project acts upon themes, which are driven from the Espoo Story and the development programs of the city.

InnoEspoo tries to match emerging service design needs from the City of Espoo and encourages different actors from educational organizations and companies in the area to collaborate and find solutions. One of the objectives is also to tap into the innovation capabilities of students to find new business models for public sector needs. This is a great opportunity for young entrepreneurs to test their ideas in real life context. In addition they have an opportunity to find help and guidance and even business partners in co-creation processes with students and staff from other institutions and from other school levels.

InnoEspoo offers coaching, workshops, professional and social networking events for everyone associated with its member organizations. Opportunities for informal exchange of ideas and sharing of good practices are offered. These business related networking events are organized in innovative facilities that are designed to foster collaboration and community spirit.

The starting point of InnoEspoo project is to find the best potential and to facilitate unexpected encounters, making creative and unlikely business ideas to materialize. One example is a startup company run by students majoring in theoretical philosophy. These philosophy students are offering coaching in sales competency successfully to other startup companies. One of their clients is a group of artisans, who recently graduated from vocational institution. Startups, entrepreneurs, philosophers and artisans can happily coexist in the InnoEspoo community, helping each other to fulfill their dreams. Unlikely encounters, effective results.

ACSI helped to focus and move on in building Collaboration

Aalto Camp for Societal Innovation, ACSI, is an innovative international program that was co-initiated in Espoo by Aalto University and the New Club of Paris. ACSI is a new generation innovation agenda bringing forth a concept, operating mode and network fostering the integration of research, learning and innovation in real life cases. ACSI brings together innovators, field practitioners, researchers, entrepreneurs and students from all over the world to co-create and test new and promising ideas to address societal challenges. Challenges for this global innovation platform are presented by companies, cities and other stakeholders. Espoo has been active in supporting and participating in ACSI since its beginning in 2009. See more Aalto Camp for Societal Innovation.

In year 2013 ACSI was organized in Malmö, the first time in the full format outside of Espoo and Finland. The City of Espoo presented this time in ACSI the challenge of "How to accelerate the collaboration between the city and educational institutions". By prototyping ideas both during and after the camp in several countries and contexts the ideas started to develop (see Figure 2). Network of Smile was an idea that was disarming and inviting to join in collaboration by simply asking "What makes you smile?" Various variations were tested. The lessons learned were that the culture of collaboration should be developed to be more open, flexible and pioneering. It should be a culture of exploration and discovery and prepare for the unknown future. In addition, this collaboration should clearly bring added value to all parties and the actors should also have fun during the process. The other prototype model was City Campus Collaboration, which looked for places for meeting and co-creation. In addition, ideas to activate and boost collaboration in these meeting places were tested. Lesson learned was to identify common meeting places where both planned and unintended co-creation can happen.

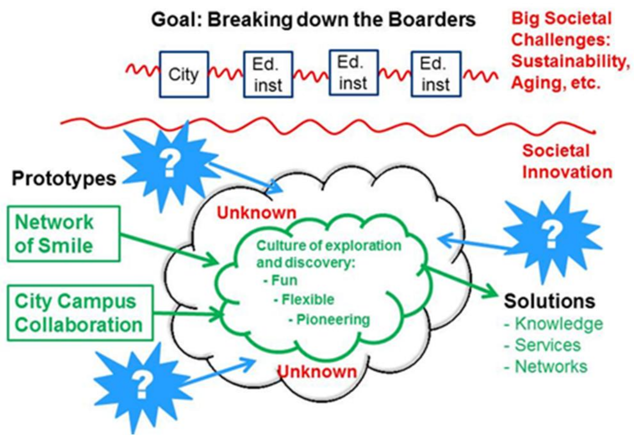

Figure 2. Espoo Challenge Framework in ACSI 2013

Shared Platform, Real or Virtual

Now the city has taken more active role in being the driver in this collaboration with the network of educational partner institutions. There have been several workshops in order to learn from the experiences in ACSI and InnoEspoo and to tackle the Espoo challenges in collaboration. This is an opportunity for the educational institutions to offer real life relevance for their teaching and research. The students can test ideas and learn in an authentic environment and they can collaborate with professionals from different fields. What might be most rewarding for them is when they realize that their contribution matters. Another goal is to get the educational institutions to work together across different type of organizations on different educational levels. Why not ask people from vocational institutions, university of applied sciences and research universities to work together complimenting each other's competences in finding solutions for difficult problems? This is an opportunity to try out new combinations of products and services in a test bed which is a shared and safe platform. It might be also easier to find outside funding to more substantial projects and programs which combine talents from multiple fields of study and several institutional levels and address real life complicated problems that have been identified in the city.

There are plans to identify common meeting places for collaboration across Espoo and to put them on a virtual map. It would be a platform for innovative meeting places i.e. hubs in Espoo area. These places could be locations that already exist, perhaps adjacent to an educational institution. Typically they are currently not open to anyone outside the institution. If we could open those places for students and researchers from other institutions, employees from businesses, entrepreneurs and other interested parties to enter, it could boost new collaboration and innovative practices. This could make the places for collaboration and most of all the activities visible and open for others to join. A virtual map could be a wiki-type of map where users could enter data and those in the network can see it in real time. This way it would be possible for example to seek partners with needed competences and interests to join a project. In addition, accomplishments could be made visible and celebrated.

As part of ACSI activities a virtual map of Espoo, with recognizable geographical areas, was prototyped by a private company. The few existing hubs were identified and placed on the map. So far the most developed and open hub of this kind in Espoo is Urban Mill. It is an emerging, thematic focal point for Urban Innovations. Urban Mill has co-working and co-creation space in an old warehouse in Aalto University Campus. Urban Mill brings together research and innovation actors of built environment development, ubiquitous & responsive city ICT, urban services and urban life transformation. Urban Mill's startup phase was launched in January 2013 as a joint effort, where the main actors were the City of Espoo and Aalto University. The development work is orchestrated and the space operated by a private company. Kakko (2013) has been typing and elaborating on dimensions of Urban Mill among other Third generation science parks. See more Kakko, Urban Mill.

A Smart City develops in a Smart Ecosystem

Higher education institutions have been identified to have a central role in building a brighter future for Europe according to the Europe 2020 strategy. Universities are known drivers for development in their area. However, one of the major gaps in reaching for success is recognized to be the transfer between knowledge obtained through research and real-life practices. University's role has been extensively studied in that context and for example Markkula (2013) has elaborated it by describing the case of Aalto University. Markkula advocates that a major change is needed within universities and that the disassembly of silo structures and accomplishment of an in-depth collaborative working culture form the key stepping stones to do so. He points out two means in getting forward: modernizing Tipple Helix PPP-collaboration model and the need for Knowledge Triangle collaboration to gain ground. The concept of Tripple Helix according to Etzkowitz in the 1990s was university-industry-government relationship in the Knowledge Society. Since that the concept has developed and nowadays it is referred mainly as the cooperation between universities, enterprises and public administration together with public-private partnerships. However, there are claims that there is a need to add the fourth P, i.e. people, so that it would make the model more functional. Knowledge Triangle model shows collaboration and synergy between the key university functions; research, education and innovation. These two models together, according to Markkula, are the central elements to form the avenue towards regional innovation ecosystem where universities drive societal change. (Markkula, 2013, pp. 16-17).

Universities have a challenge ahead to develop their own processes, structures and academic culture to meet their societal role. If universities want to be the drivers in regional development, they need to do their research task and disseminate their findings, that can be valuable for the society and businesses, and they need to link their Knowledge Triangle through collaboration with the wider community. Universities themselves need to improve the impact of investment in these activities by systemic and continuous interaction. (Markkula, 2013, pp. 15-19).

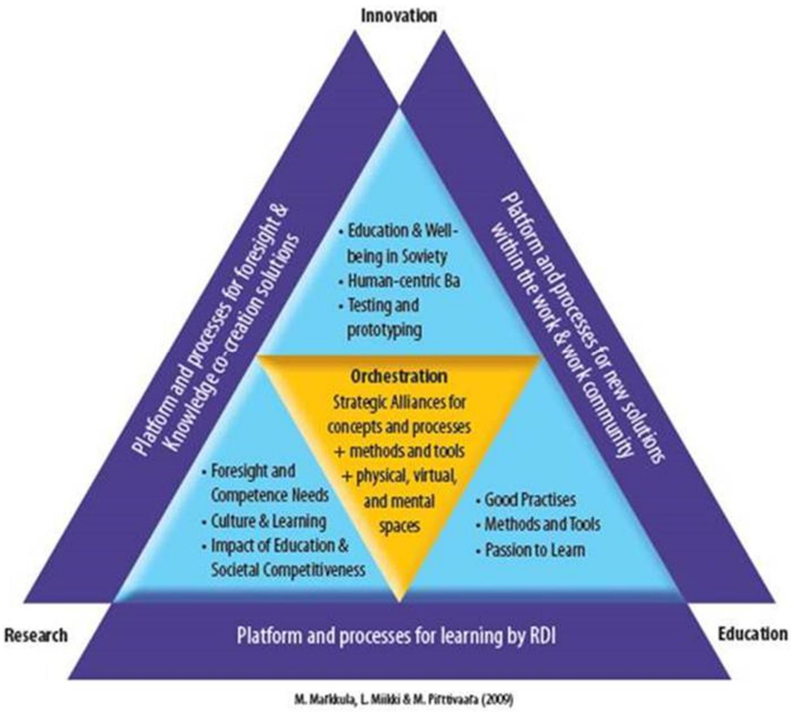

Figure 3. The Knowledge Triangle Framework in University Context (Markkula 2013, p. 25)

Orchestration has a central role in the Knowledge Triangle to make it function successfully. Figure 3 illustrates the Knowledge Triangle concept framework according to Markkula (2013) with some crucial contents and critical success factors. Even though this is presented in the university context it is important for those who are operating in the ecosystem with universities as drivers to understand the synergies in the university operation. In addition, the orchestration within university can be considered a point of reference to rethink operations within other organizations. The expectation of interaction and search for synergy could be as well obtained in the city. The concept of orchestration and the role of the orchestrator should be considered more often in the city context as well.

Markkula and Kune (2012) advocate, that innovative regions are enablers for the Europe 2020 strategy. They suggest that regions should be turned into innovation platforms for strategic change. There should be a new dynamic understanding of regional innovation ecosystems, where public, private and the third sector operate together, side by side, instilling a new and creative mood in society. Some promising examples can be found already in Europe. They showcase The Helsinki Region as an example of such forerunners.

According to Viitanen, Markkula and Soler (2013) innovative regions need a hub system which in fact is an innovation ecosystem. In their opinion, in the future every internationally attractive innovation hub requires a core hub organization for the key management functions in many central tasks. The most critical management issue for all innovation hub organizations according to them, are the coordination of parallel, partly even conflicting sectorial interests, and the orchestration of common collaborative interfaces. They call the orchestration of activities between public and private sector in this complex environment smart orchestration. See more of Hubconcepts Launonen and Viitanen.

As part of the Helsinki Region, the T3-area within and around Aalto University main campus has been the innovation ecosystem spearhead in the City of Espoo. There are several innovative projects going on in this area and they all try to play a complimentary role in bringing T3-area as one of the forerunners in Europe. One of such projects is the EKA Helsinki Region project. It is an instrument to assist the regional actors in defining the necessary activities to prepare the Helsinki Metropolitan Area to act as the engine of the international success of Finland and to take a role of a European pioneer as an innovation ecosystem.

Another example could be Energizing Urban Ecosystems, EUE, which will create and apply operational models and solutions to the challenges posed by urbanization. See more EKA B Project.

A good test for the City of Espoo and the T3-ecosystem was the resent application process for the first search for the European Innovation Capital. More than 150 people participated in the intense process of two months to get together the winning application for iCapital Espoo. Weather the City of Espoo is the final winner or not, we have already made a winning entry - at least for Espoo. One of the initial accomplishments was that together with all the content and material that went into the application, we came up with the name of Espoo Innovation Garden instead of T3 which was really hard to translate to language for anyone, who was not an insider.

Conclusions

A smart city can no doubt gain through smart collaborations. In this article I have pointed out how the City of Espoo has changed its strategy, policies and practices to engage in and benefit from collaboration. The focus of analysis has been in the collaboration with educational institutions. Universities have been in many cases nominated as the drivers in the change for the better future, but they still have within their own organizations problems and challenges that need to be addressed. None of the actors operate alone. Before Espoo can really be successful, the ecosystems that it is part of need to improve. By seeking excellence the City of Espoo can make changes for the better within the city's own operation.

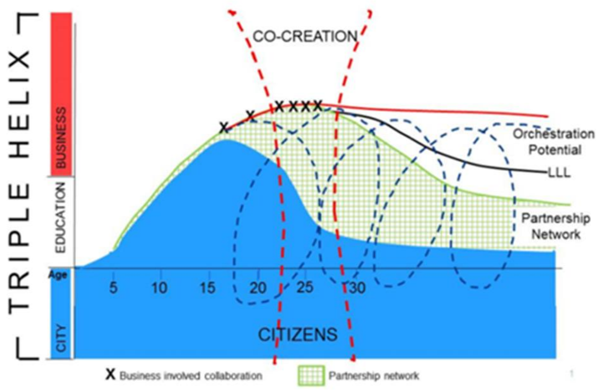

Figure 4. Potential in Espoo Educational Collaboration

In the partnership with educational institutions there is a great resource at the city's disposal, but it has not been used to its full potential yet (see Figure 4). From individual's perspective the city provides services, also in education, and opens up opportunities. The city has realized that it can benefit from schools and universities around it, but according to the modernized Tripple Helix model the two other aspects are mostly missing, namely business and people, the fourth P. In rhetoric they are both mentioned, but in reality the involvement is not there yet. Bottom up initiatives should be recognized and they should be given forums to bring up ideas and suggestions. One way to enable more of these to happen would be to bring Living Lab practices, that some of the Espoo's partner education institutions have successfully deployed, to the center of development practices within the city. The other key idea to boost collaborative development and to get more out of networks in and around the city is to learn from leading universities and innovative ecosystems: the use of smart orchestration. Orchestration is needed in complex systems to get the most out of the potential there is.

After all, the purpose of these activities is to open the city as one development platform, a Living Lab as a whole, and to make Espoo in collaboration a better place to live, learn and a place to engage in entrepreneurship.

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About the Authors

Kristiina Erkkilä Director of Development, Ph.D., M.Ed., The City of Espoo, Education and Cultural Services

Idea Management System for Smart City Planning

Lanfranco Marasso, Enza Giangreco, Davide Storelli, Valentina Chetta, Alessio Camillò, Giuseppe Turrisi, Giulia Antonucci, Mario Barile, Bruno Centrone, Daniele Papadia & Francesco Simone, Puglia Smart Lab - Dhitech S.c.a.r.l., Lecce, Italy

Abstract

The article describes an experimental method tested in Lecce (Italy) which introduces a city vision as a Living Lab, where the general public has an active role in the process towards Smart City paradigm. The methodology moves from considering a Smart City not just a technology environment, but also an organic system where public institutions, organizations, enterprises and citizens collaborate with each other to co-design and co-create integrated services supported by technological innovation. The framework developed regards the implementation of an Idea Management System (IMS) to support citizens participation in the context of the candidacy of Lecce as European Capital of Culture 2019. The application, which is now focused on ideas sharing and voting, will be further developed to cover the whole idea management process. "Lecce 2019 – Idea Management System" will then be used as a tool to support Smart City planning. The aim is to implement open innovation and knowledge sharing practices, extending these to neighboring municipalities in Salento.

Keywords

Smart Cities; Living Lab; citizen engagement; co-creation; Idea Management System

Introduction

Counting 90.000 citizens, Lecce is a mid-sized city which represents the most important province of Salento sub-peninsula, located at the "heel" of the Italian "boot". Even though Lecce is known for its enormous cultural, artistic and naturalistic heritage, it can also be considered as a typical example of southern Italian city from a socio-economic point of view: poor in infrastructure, with high and increasing unemployment rates and deeply influenced by various criminal networks. But, despite this disadvantageous context, remarkable investments in research, university education and tourism sector have been taking place during the last few years, making Lecce an area of attraction on an international scale. In fact, the only possibility of redemption for the territory is to bet on a radical change. The change is aiming at obtaining a deep innovation of Lecce and Salento, starting from a concrete enhancement of their resources, where citizens are extremely important. Three opportunities can be highlighted in order to reconsider the territory in a more innovative and respectful way for the citizenship: the participation to the National Smart City Observatory, where Lecce is one of the pilot cities together with Benevento, Pordenone and Trento; an urban planning co-created with the citizens; the candidacy as European Capital of Culture 2019.

The practice described in this article covers the implementation of "Lecce 2019 – Idea Management System", a web application developed to support citizens' active participation in the initiatives for Lecce candidacy as European Capital of Culture.

From "Triple Helix Model" to Idea Management System

A key purpose of IMS is to support an open and user driven innovation approach (Recordon, 2006). The concept of "openness" is referred to the evolution that, starting from the disadvantages of the linear model of innovation, leads to an "open" model in which a variety of bodies collaborate towards a common goal while following their own objectives. The advantage of this approach is the non-linearity of the innovation process, that allows the enhancement of cooperation and the use of feedback systems between the parties involved. The path towards the "open innovation" concept consists of two main steps:

- "Triple Helix" model, regarding the creation of a network between universities, research centers, public institutions and SMEs, represented in Italy by Technological Districts (Etzkowitz & Leydesdorff, 2000);
- "Quadruple Helix" model, identified in the Living Lab approach, which adds user in the co-creation process (Ahonen & Hämäläinen, 2012).

Living Labs can be used as a tool to support a democratic society where people participate proactively. Hence, the network advantages enabled by "Quadruple Helix" characterize not only market oriented creation/delivery processes, but also the initiatives related to the creation of public services.

"Lecce 2019 – Idea Management System" was originally designed in order to support the activities of Puglia Smart Lab Living Lab, which was born in Lecce in March 2013 and, in a broader sense, to foster the development of a smart community. Puglia Smart Lab is an innovative space where citizens, Public Administration and enterprises can work together in order to identify and cover the urgent needs in Lecce, used as a pilot city. The Living Lab is composed of a network of public partners (Municipality, Province and Local Health Authority of Lecce, Chamber of commerce, Firefighters, University of Salento, University of Bari, Polytechnic of Bari, San Raffaele Hospital), public-private partners (Dhitech Scarl, X-Net Lab) and private partners (Engineering and Exprivia). Puglia Smart Lab also includes the citizens association "Vivere Lecce". In particular, the LL is the first tangible result of Puglia@Service, a project supervised by the Technological District Dhitech Scarl and co-funded by the Italian Ministry of Education, Universities and Research as a part of the Research & Development Piano Operativo Nazionale 2007/2013. The project's scope is to achieve a structural change in the Region of Apulia, focusing on innovation, advanced tertiary and "Knowledge Intensive Services" (KIS) development. The project includes:

- Puglia@Service research team, focused on achieving a methodological and technical infrastructure to support the definition, development and management of KIS;
- Activating Puglia@Service, a two-year Second Level University Master, designated to create a new job profile for 15 young professionals with backgrounds in sciences, economics and technology.

Citizenry involvement

Public administration and citizens are generally not coordinated with each other, since the traditional approach of urban planning is top-down; this approach often does not match citizen needs. As stated previously, the Public Administration of Lecce is trying to change approach, creating a shared path towards a social model in which a direct participation and collaboration of the citizens is included. In the guidelines of the candidacy as European Capital of Culture, one of the main criteria of the bid book evaluation is "the city and citizens", referring to concrete initiatives that must be launched to attract local, neighboring and foreign citizens' interest and participation. Moreover, these initiatives should be long-term and should be integrated in cultural and social innovation strategies. The challenge of the candidacy is making Lecce a Smart City, which means moving towards an innovative ecosystem that improves citizens' quality of life through an efficient use of resources and technologies. A fundamental aspect is citizens participation, aimed at collecting their needs as beneficiaries and main characters in the open innovation process.

In a distrustful environment towards the public institutions, which is a general characteristic of the South Italy, involving citizens and individuating their needs are two very critical elements for Lecce candidacy. The urgent need to express a strong break with the past is well summarized in the slogan for Lecce as European Capital of Culture: "Reinventing EUtopia", that means reinterpreting the European dream from a political, social, cultural and economic perspective. That concept is composed by eight utopias for change, the main one being DEMOCRAtopia until 2019. As described in the bid book (Lecce2019, 2013), DEMOCRAtopia refers to the creation of a climate of trust, awareness, collaboration, responsibility and ownership, with a special emphasis on the collective knowledge and on a development perspective oriented to citizens' dreams and needs. Among the initiatives concerning this utopia there are LUACs (urban, open, creative laboratories) which are basically a kind of informal debate, aiming to satisfy citizens' need for participation. "Lecce 2019 – Idea Management System" was adopted to integrate LUACs and other initiatives that enable interaction with and between the citizens. With the use of modern technologies, efforts are being made to improve accessibility and social inclusion.

The territory

From an economic point of view, Lecce is traditionally a city focused on trade, agriculture, crafts and gastronomy. However, Lecce and Salento in general are increasingly becoming an international tourist destination because of their enormous cultural and naturalistic heritage. That is one of the reasons why service sector is extremely important. The economic trend of Salento and of southern Italy in general, has never been in step with northern Italy trend, and it has recently got worse due to the global economic crisis. As an example, Camera di Commercio Economic Report 2013 (Camera di Commercio Lecce, 2013) shows that from 2008 to 2012 unemployment rate grew by 23,5% in the province of Lecce, and in 2012 it reached 18,3% (youth unemployment rate was 43,8% in the same year). The socio-economic trend and the effects of crisis have also impacts on Lecce quality of life. In fact, the city is only placed on the 90th position in the 2013 national ranking published by Il Sole 24 Ore (Il Sole 24 Ore, 2013), a reputable Italian national daily business newspaper. Despite this, 2013 Between Smart City Index (Between, 2013) put Lecce on an above average position for smartness, because the city showed good results in Broadband, Alternative Mobility and Renewable Energies. Moreover, although the balance between the birth and death of enterprises is generally negative, the companies founded by those under 35 years old seem to be on the rise. By matching these two data, Between described Lecce as one of the Italian cities with the potential to redeem, becoming a Smart City. The political administration has set new goals for the development of the territory and is facing the challenge required by the contest of the European Capital of Culture towards an inclusive Smart City approach involving the general public. From a technological point of view, some meritorious resources make Salento distinguish, like the University of Salento, corporations and research institutes, such as CNR (Center for Nanotechnology) and Technological Districts. These have given to the city a flourishing technological and innovative potential.

During the drafting process of the programme for Lecce Smart City, the Governance has decided to confront this challenge through the cooperation with the citizens. In this perspective, the administration has chosen local resources identifying the elements that could support the planning: Lecce Smart City Committee and Lecce 2019 Committee. Puglia Smart Lab has collaborated with the local administration and the Committee for Lecce 2019 in order to process and re-arrange information obtained during LUACs face-to-face meetings and to collect city user ideas through an innovative technological support.The IMS project was born in this context, with the aim not only to collect urban ideas and requirements but also to monitor and manage the whole processes of idea marking/voting, selection and project development, with a perspective to share information with the whole city.

The IMS, compared to PEST analysis (figure 1), ranks in this way:

- from a political point of view, IMS supports the Governance challenges (Lecce 2019 and Lecce Smart City) as a practical tool for e-democracy
- in terms of potential economic impact, IMS enables knowledge sharing and the opportunity to develop and design ideas in order to promote the emergence of new economic initiatives;
- IMS addresses social problems and breaks down prejudices, like the mistrust towards the institutions which is resulting from the current socio-political situation. Moreover, IMS is trying to involve Lecce citizens directly;
- IMS analyses the outcomes of the research conducted by the project Puglia@Service, supporting its implementation and testing its validity on the territory.

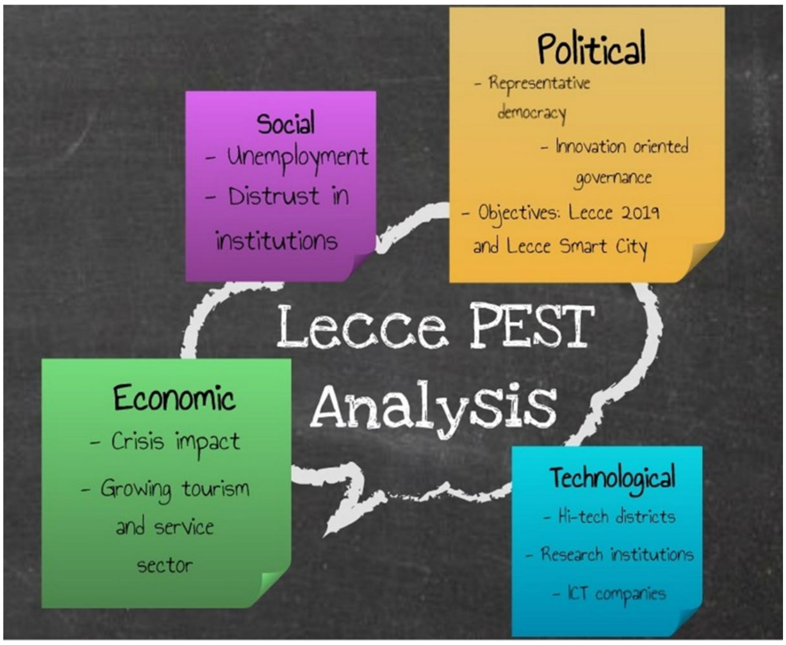

Figure 1. PEST Analysis

The IMS Solution

Web 2.0 has changed the society in a digital society where the users have an active role in the creation of ideas and contents through new tools like Blogs, Wikis, Social Networks and Podcasting. These tools have helped communication and interaction with the users and among users. This change leads to a wider user involvement, mainly in the innovation processes of products and market oriented services. This involvement is leading to the transition from "goods-dominant" to "service-dominant" perspective, where enterprises do not create value but can only propose value: the value is co-created with the customer. Similarly, the process of co-creation develops within society causing new innovation processes. The adoption of an innovative tool to involve digital society, give voice to citizens and local beneficiaries and process contents in a specialized way by making data accessible to users has emerged as a need during the meetings with the local administration. During the studies and research of the Living Lab Puglia Smart Lab several solutions were analyzed to develop a sustainable, effective and functional path towards shared goals. Indeed, Puglia Smart Lab innovation is driven by the creation of new services through ideas, data, information and knowledge. Innovation is made possible by collecting new ideas and know-how via modern approaches and tools. Idea Management Systems (IMS) are one of the best solutions for this purpose. These tools, already adopted within enterprises, are able to avoid failures due to implementation of products or services that do not suit market needs. IMS can be defined, therefore, as a process of needs recognition and ideas generation and evaluation (Vandenbosch, Saatcioglu & Fay, 2006). As ideas are the raw material for innovation, their management is essential to the success of a project and can be considered as the core of innovation, especially for territorial development planning. IMSs are relatively simple tools that aim primarily at valuing knowledge and intelligence of a community and helping the government bodies to exploit this information in a constructive and useful way to meet concrete needs. A local policy of innovative participatory democracy can be started through such a tool, obtaining structured information created by the local community. The use of an IMS in the field of public Governance aims at testing a new method of involvement of local beneficiaries in an active manner. Local administrations and the Living Lab Puglia Smart Lab have assessed the IMS useful as an innovative solution to the full involvement of citizens complementary to the LUACs instead of the usual questionnaires. This approach has been the key of the project "Lecce 2019 Idea Management System" as a tool that allows to combine expectations with the new challenges to be faced.

IMS implementation: Gi2Mo

Puglia Smart Lab research on IMS has focused mainly on three macro-categories in order to select the best solutions for a PA usage:

- The first macro-category derives from the European research. In particular three projects co-funded by the European Commission have been deepen: COIN (COIN Project, 2008), LABORANOVA (LABORANOVA, 2006), ECOLEAD (ECOLEAD, 2008). Each project offers several tools (Open Source and not). In particular COIN project uses C3DDS, C3P, PPS, cQMS, COLL4PM, CVT, TIS, TOHS. LABORANOVA is based on Distribuited Feedback, Idearium, IDeM, InnoJam, InnoTube, Melodie, ProfileSystem, refQuest, Rich Knowledge Meetings, Xpertum. Finally ECOLEAD makes use of Dynamic VO creation assistance, VO collaboration and performance measurement, Contract negotiation wizard, VO management e-service, Collaborative problem solving support e-services, Advanced collaboration platform for PVCs.
- The second macro-category includes market tools of IMS as Accept360 Idea Management (Accept Software, 2012), CREAX Innovation Suite 3.1 (CREAX, 2013), CRITflow (CRITflow, 2014), DataStation (Datastation software tool, 2013), e-tipi (e-tipi software, 2010), Hype Innovation (Hype Innovation software tool, 2014), IBM Idea Factory (IBM Idea Factory software tool, 2014), IDEALYST (IDEALYST, 2014), INPAQT (INPAQT, 2014), ID8systems (ID8systems, 2013), Ideas Management Platforms 2.0 , etc.
- Finally, the last macro-category includes Open Source tools: IdeaTorrent (IDEATORRENT, 2013), BBYIDX (BBYIDX, 2010), id-Force (id-Force, 2014), OpenideaL - Idea Management (OpenideaL, 2013), Gi2MO (Gi2MO, 2014), Idea Box (Idea Box, 2009).

The implementation of the "Lecce 2019 IMS" was performed using the tool Gi2MO IdeaStream which consists of a set of modules able to customize Drupal (a known CMS) in order to make it work as a System of Idea Management. Drupal is an excellent tool to meet the technical demands required by the "common client" (Larrinaga et al., 2011). The strength lies on its flexibility, its continuous evolution and supplies with simple procedures for administering and updating the content. The goal of Gi2MO is to provide the basic functionality of Idea Management Systems currently on the market and make them available Open Source. The selection criteria were the type of license, the ease of use, the development language, the operating system, and the integration with social networks, semantic web, blogs, wikis, RSS, email, etc. The decision to use Open Source (OS) software offers the following benefits:

- Cost-effectiveness: since the cost of proprietary software is a considerable expense, the use of an OS software gives the possibility to switch to other suppliers to receive support.
- Security and Reliability: the software is more secure because the user can view the source code and improve it. The product is, therefore, more stable and always updated.
- Freedom: OS software allows the interaction between multiple systems in a simple and fast way having the source code always available.

The software OS that concerns several European projects has not been chosen because most of them are in an experimental phase. In particular, Gi2MO defines the life cycle of the idea that enables to coordinate the various phases and perform the individual steps of the management and also monitors the ideas proposed. Gi2MO is closely linked to the process of the project co-creation "Lecce 2019 IMS" which supports users' involvement in the whole process of creation and innovation. The main IMS functions implemented for "Lecce 2019 IMS" can be found on the website "http://ideeperlecce.it" and are divided as follows:

1. Collection and sharing of ideas: this system provides methods and tools that make ideas evaluation and aggregation more effective. The user has a web form with an intuitive and easy to understand interface, that provides a standardized way of sharing ideas.
2. Collaboration for the improvement of ideas: it allows idea sharing, comments and votes. Ideas are made available to the whole community, that collaborates to transform them into a structured project. Therefore the community, properly supported, can improve ideas, exploiting know-how and multiple perspectives emerging from the system.
3. Tags and categorization of ideas: topics and specific concepts related to the content that was created are shown, simplifying then the organization and the search of ideas.
4. Cross-valuation of ideas: charts show the most popular ideas and suggest the most active members of the community. In this way, the ideas most read, commented or appreciated emerge and are highlighted more than the others.
5. Analysis, filtering and tracking of ideas: it provides statistics and graphs that depict the performance over time of the Idea Management System. All contents of the system in the form of a summary table and the frequency of interactions within the community can be displayed.

IMS: results and impacts

The importance of this tool for the involvement of citizens and its impact on the territory are confirmed by the acceptance of Lecce to the second stage of selection for the candidacy as European Capital of Culture 2019. It is important to specify that the Evaluation Committee, composed by Italian and European members, mentioned verbally Idea Management System as one of the elements that have positively influenced the Committee decision.

Regarding the accesses to the platform, a correlation between the number of visits and the interest shown by the citizens towards the "Lecce 2019" initiative is evident. The launch of the site, which took place in July 2013 with the start of the LUACs, showed a steady increase with a peak in September, near the deadline for the submission of the bid book application. From that moment onward there was a decline stopped in November near the communication of the results of the first selection phase. After this step, there was a further decline, except during the LUACs in December. It can be concluded that the number of accesses and interactions is strongly influenced by the dissemination activities of the various initiatives and upcoming deadlines. These trends demonstrate that citizens are not loyal to the platform and do not perceive it as an effective tool of interaction with the community and with the Local Public Administration.

Despite these problems, a common need expressed by the citizens, which has been taken into consideration by the Local Government, has emerged through the platform of IMS: the creation of a food bank to allow the reduction of food waste through a platform connecting users who want to donate food and those who request it. The identification of this need has originated specific Living Lab sessions, which involved the Deputy Mayor of Lecce, Carmen Tessitore, the Councilor for Innovation Alessandro Delli Noci and representatives of Lecce charity organization "Caritas Diocesana". These sessions brought out the practical requirements of the stakeholders and the critical issues to be addressed in order to create a food bank service based on a mobile application.

Lessons learned and future developments

"Lecce2019Idee - Idea Management System" test provided to researchers a lot of technical and conceptual hints for future developments. First of all, the IMS tool could be adapted to different contexts and for a variety of interactions between government entities and citizens, but it is necessary to implement further improvements and technical interactions. As an example, a more friendly user interface and a mobile version could allow the integration with mobile messaging tools. This could be helpful especially for people unlikely to use new digital devices.

Having a moderator is fundamental in order to preserve the platform essence (aggregator of ideas and perspectives), since he/she could have alternatively two different roles:

- spamming activities checking;
- inappropriate contents detection.

However, it is necessary to pay close attention to the latest role since it could even be seen as an attempt to restrain freedom, that is one of fundamental characteristics of the IMS tool.

Another lesson learned during the test of IMS concerns its adoption by city users. The outcome of the statistical analysis showed that the use of "Lecce2019 – IMS" was closely linked to the candidacy of Lecce as European Capital of Culture 2019 and hardly ever used to give a contribution related to personal interests. In the next future, the promotion of an Idea Management System tool based on the model of "Lecce2019 – IMS" will be implemented including incentives like call for ideas and gaming methodologies in order to stimulate the usage of the IMS as a social innovation tool in order to generate a wide involvement. Specifically, techniques and theories of gaming could create a strong emotional connection with the user/player to drive, build, modify, or stimulate participatory behaviors. Moreover, a direct analysis of the indexes and the statistics systems will be performed and it will be useful to measure ideas and proposals of citizens for future implementations.

A new extension, called "index of vitality", is currently under development. This new extension aims at integrating the potential of sentiment analysis to identify the issues of greatest interest to the community. However, the usage of an idea management system to support strategic planning in an open environment, such as urban areas, introduces a problem: administrators need further tools to prioritize efficiently interventions in the urban context. For this reason Puglia Smart Lab is working to extend the capabilities of the idea management system by introducing an algorithm that could calculate the vitality index of an idea or provide feedbacks on the degree of participation and discussion of ideas within the local community. The vitality index will be calculated from a set of input parameters, resulting not only from the idea management system, but also by means of the major social networks like Facebook, Twitter, Google+ and LinkedIn. In particular, the vitality index of the ideas will be calculated on the basis of different parameters with particular weight to those originating from social networks (shares, comments, critical mass of topics, posts, keywords used). The index described includes the functionality of voting the idea developed for Lecce2019 candidacy and, at the same time, provides the Local Public Administration with a much broader perspective, assessing the visibility and the degree of collaboration around an idea. On the other hand, sentiment analysis instruments using specific algorithms as well as semantic functions, will have the purpose to simplify and to categorize contents. Founded on the concept of interoperability, the project proposes a number of solutions using metadata and providing new methods of evaluation: metrics based on opinion mining, taxonomy and categorization of innovation, as well as metrics based on reports of the idea. The semantic web approach may be particularly useful for the subsequent implementation phases of the project, allowing a connection of the Idea Management system with other sources in order to extract a greater number of idea descriptions at every stage of their life cycle. In fact, in a future evolution of Lecce 2019 – IMS, additional modules will be deployed to support the entire idea life cycle (figure 2), from the generation to the development.

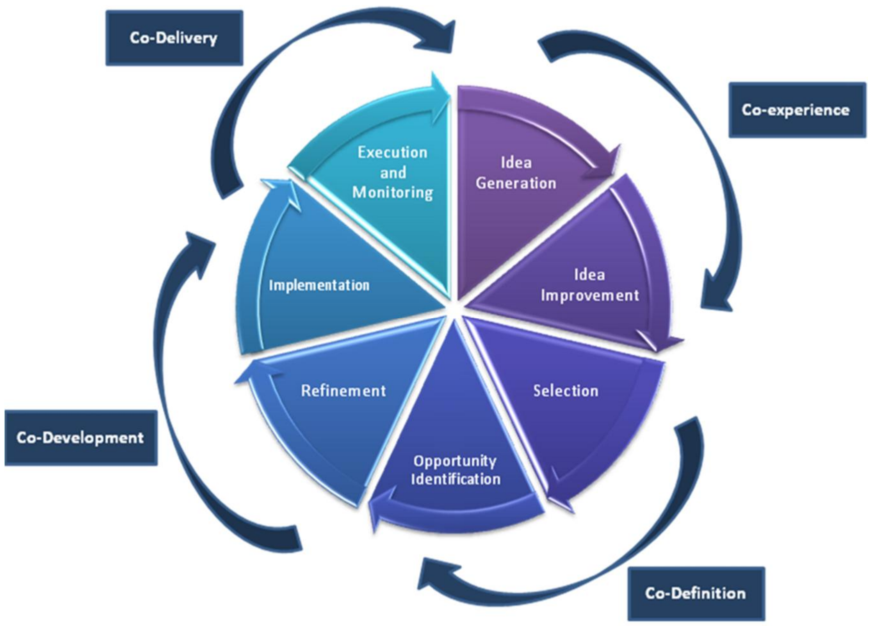

Figure 2. The Idea Life Cycle

In particular, the add-ons of the life cycle modules described, like the vitality index and sentiment techniques, are already being developed in the Living Lab. These tools are in the testing phase, waiting for the Public Administration to decide how and when to access these add-ons in support of the subsequent phases of Smart City planning.

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About the Authors

Lanfranco Marasso, PhD, has a role of Puglia@Service Project Director on behalf of Dhitech, the technological district of Puglia. He is currently R&D Knowledge Transfer Director at Engineering Ingegneria Informatica spa, working on next generation of public sector services. He has spent many years in management roles (CEO, CIO) both in private than public sector in Italy and abroad.

Enza Giangreco, she has been shaping the strategic vision of the research team of the Engineering R&D Lab in Lecce, while directly contributing to research streams in the areas of Open Government and Open Innovation.

Davide Storelli, he coordinates the technical activities of the Engineering R&D Lab in Lecce and co-defines new research streams in the areas of Open Government and Open Innovation.

Valentina Chetta, as consultant of Engineering R&D Lab in Lecce, she directly contributes to the research activities in the areas of new business models and new sustainability models for public-private-people partnerships.

Alessio Camillò, with a long experience in complex systems design and development (e.g. energy monitoring, social platforms), as consultant of Engineering R&D Lab in Lecce, he recently contributed to the development of the technological platform that underpins the IMS discussed in this paper.

Giuseppe Turrisi, with a strong experience in ICT development challenges, as consultant of Engineering R&D Lab in Lecce, he recently contributed to the customization of the technological platform that underpins the IMS discussed in this paper.

Giulia Antonucci, graduated in Business Management. Currently engaged in Activating Puglia@Service project with the aim of studying new business models for ICT services co-creation via the Living Lab Puglia Smart Lab.

Mario Barile, degree in Marketing and Communications. Member of Activating Puglia@Service project and co-founder of Puglia Smart Lab, he focuses his activity on social innovation and innovative business models.

Bruno Centrone, currently working on Activating Puglia@Service project, he aims to enable smart communities through a bottom-up approach, collecting community ideas and needs. Smart City strategist and co-founder of Puglia Smart Lab, a Living Lab where services are co-created with citizens, Public Administration, local institutions, research bodies and enterprises by means of the PPPP paradigm.

Daniele Papadia, graduated in Telecommunications Engineering, he is currently involved in Activating Puglia@Service project in the field of innovative entrepreneurship, focusing on the development of Internet-based services for a smart city. Member of the Living Lab Puglia Smart.

Francesco Simone, a Computer Science graduate, currently participating in Activating Puglia@Service project in the field of innovative entrepreneurship with the aim of building a smart territory.

Energy Complex as a Catalyst for the Sustainable Development of the Russian Regions

Alexey Ilyin, Dmitry Makhnev & Valery Yanovskiy, North-West Institute of Management – branch of Russian Presidential Academy of National Economy and Public Admnistration, Russia

Abstract

The article describes current conditions of power industry in Russia through the lenses of regional development. Key problems and perspectives of the industry and key stakeholders are considered in the article. Specific steps in order to increase the efficience in the industry are proposed. We emphasize that today it is possible to build own generation, avoiding centralized power supply. It is available for an increasing number of consumers. Power system development via these modern technologies initiataes innovation across multiple spheres and will create the impulse for modernization of our domestic national economy. State modernization of our national power complex becomes the first and important step along this path.

Keywords

Region, sustainable development, heat-and-power engineering, state program.

In the modern world, 'power' is a major factor in sustainable territorial development. It defines levels and rates of growth for regions and countries. The first researchers who noticed the correlation were D. Meadows of the US and P.L. Kapits of the USSR in the 1970's. They recognized a rigid correlation between the level of economic development and the 'installed' power per employee in a country's development. Economic growth accopmanies with accelerated increase of power, and the rate, the structure , stability and security of economic growth of territory depend upon this increase.

In 1990, just after the Berlin Wall fell, American economist John Williamson presented recommendations called the 'Washington Consensus'. This was based upon a broad range of factors including a budget surplus, reduction of state expenses and their localization in medical science education and infrastructure, expansion of the tax base, a favorable exchange rate for exporters (further — freely floating rate), liberalization of foreign trade, liberalization of the inflow of direct foreign investment, obligatory privatization of state enterprises and deregulation of the economy.Guaranteed property rights, as

Williamson confessed, were added there just to make an even number of sub-sections.

During the early 1990's, shortly after the collapse of the Soviet system, macroeconomic development practically coincided with recommendations of Washington Consensus. Fixed asset updating within the power complex happened extremely slowly. Thus the wear of fixed assets in the sphere of power and housing and communal services reached 70%, and in some branches exceeded 90%. Perhaps not surprisingly, the efficiency of massively used large equipment produced in Soviet Times is 25% less in comparison with modern equipment. These figures testify not only to the prospect of unsustainable development but even national disaster. This is especially true in 2011 when the head of IMF recognized that "The Washington consensus" with its simplified economic representations and suggestions failed during world economic crisis and fell behind". The necessity of developing a strategy to ensure sustainable economic growth at the expense of an effective power policy is now at the forefront in Russia.

How can anyone disagree Russian Federation President Putin's statement that: "In any case, power today is the driving force of economic progress. The prosperity of Russia both in the present and in the future depend directly upon our ranking in said global power. Our major problem in the Russian Federation is to create a serious catalyst of modernization to uplift the economy".

Table 1 below illustrates the dynamics of heat and electric power for the Russian Federation. A clear correlation is evident between lack of growth in electrical generation and the inevitable decrease in production.

Table 1. Generation of electrical and heating power

	2009	2010	2011	2012
Electric power, bln. kWh	992	1038	1055	1064
produced by:				
thermal electric power stations	652	699	714	721
hydroelectric power stations	176	168	168	165
nuclear power stations	164	171	173	178
heating energy, mln. Gcal	1338	1369	1334	1312

Table 2 below clearly displays recent annual stagnation of production and the profitability of organized economic activity as "the production and distribution of the electric power, gas and water" decreases.

Table 2. Key indicators of enterprise activity in business with "Production and distribution of the electric power, gas and water"

	2000	2005	2008	2009	2010	2011	2012
Index of production, inpercentage last year	104,0	100,9	100,6	96,1	104,1	100,1	101,2
Profitability of sold goods , production (work, servises), in percentage	...	5,3	4,9	6,8	7,1	6,4	4,7

It is clearly important to solve the problem of internal energy security to achieve sustainable development in Russia. Urgent tasks in our opinion within the sphere of said sustainable development:

1) Continuous inventory of objects of power in sector of averages and low powers, showed a necessity of urgent updating and replacement of outdated fixed assets for power plants and the power equipment in distributive mains.

According to available data on medium-voltage systems, the reliability of uninterrupted operations are directly reflected in city activity from total of units of electrical power equipment established in distributive networks of St. Petersburg and the Leningrad region. As of, as of 01.05.2010 term of use of 58% of the equipment older than 23 years (This term, 23 years is based upon an established period of 100% of depreciation of the equipment) (Figure. 1).

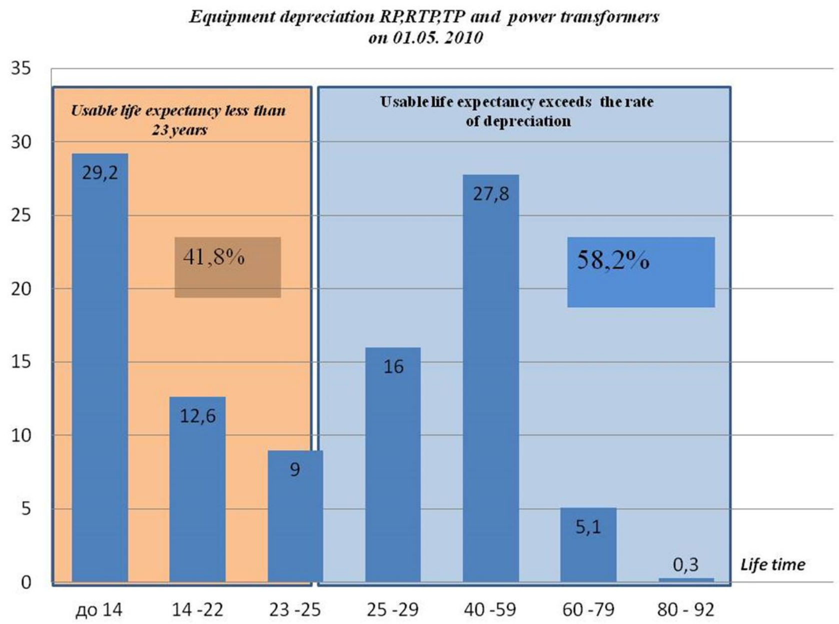

Figure 1. Usable life expectancy in medium-voltage systems

This sector is generally represented by cities of half a million residents. The issue of updating the equipment with available funds is a high priority in situations of deficient budgets.Yet without having total annual electrical power consumption, producers and suppliers start "planning" how much to increase their prices to compensate for the expenses of the last reporting period, including car repair, maintenance of fences surrounding the enterprise, tea, coffee, water, foreign exchange, business trips as well as any and all other miscellaneous production expenses. All over the world tarrifs are dictated by the previous yearly summary of actual expenses and not based upon hypothetical predictions for the next fiscal year.

According to official data of the Russian Federal State Statistics Service, over the past 10 years the tariff for electric power as increased by 300% and for hot water it has increased by 800%. According to Committee of the State Duma of the Russian Federation for Construction and Land Relations, the past ten years have seen an increase over the last 10 years for Housing and Communal Services by 9,6 while the general increase during the same timeframe for consumer prices has been much less than half of that at 3,6.

2) Depreciation for the population and prime cost electro - and heat power.

It is important to specify that in 2012 the electricity price in Russia (at recalculation at purchasing parity) for average industrial consumers made 0,122€/kWh. The price of power in Russia is 2,5 higher than in the USA, 41% higher than Germany, and 25% higher than the average price of the 27 EU countries. Only in the new EU countries as well as Italy and Turkey electricity still cost more than in Russia.

3) Modernization of production base:

The largest suppliers of power equipment (more than 90% of outdated fund) are Siemens and General Electric. Russia neither produces the equipment domestically nor are any new plants being built. This poses a clear and present threat to the power safety of this country.

4) Creation of knowledge-intensive workplaces in heat power industry at the expense of production and installation of the modern equipment.

The majority of power engineers worldwide agree that a country's own modern micro thermal power plants are the best decision for enterprise, commercial complexes, social infrastructure and community facilities. However, as the prime cost of hi-tech products decreases, investment attractiveness increases due to the economies of scale of such mass character. The government needs to create conditions for the emergence of sales markets in progressive segments.

5) Creation for equipment leasing and the inclusion of private capital and creation of conditions for regional infrastructure development in order to to increase efficiency of the construction and operation of power- infrastructure facilities.

Leasing is a rather effective instrument for business development in energy industry in order to renovate energetic equipment:

- leasing is less capital-intensive than purchasing, so business may grow more rapidly by leasing property than by purchasing property;
- lease payments can be set off against revenue when calculating taxable profit;
- payment plan depends on the industry, seasonality and competitive environment, and business can for equipment as it generates revenue.

Thus, leasing may provide more flexibility and financial benefits for business.

6) Creation of a power reserve in the territory of new productions.

It is generally agreed that the majority of territories with low power efficiency complexes their equipment to work at their maximum limit. And such serious increase in consumption (cold winter, for example) increase loads at such power complexes to ultimately lead to failure of all capacities. In the Northwesten federal district the problem with electrical and heat supplies in remote and power-scarce areas is very acute in up to 70% of those areas.

The Federal Target Program in our opinion would be the appropriate organizational instrument to solve the above mentioned problems through the following:

1. Modernization of not only concrete thermal power plants, but the entire sector.
2. It is necessary to change the key assets in energy to the Federation level since to do so at subordinate levels would involve unnecessarily large expenses.
3. To follow up to the prior suggestion, to initiate and supervise these activities at the federal level for both the efficiency of power and security for the country.

It is important to consider in more detail, the territorial aspects of a solution. We will need to analyze character of the relations of all interested parties and make a decision about specific features of the project. The power complex is closely connected with the housing and communal services system and for this reason will likely be very labor intensive to solve it all in one stroke. But it is possible to make progress gradually.

Let's consider an example of a territory with a population of 100 000 people. As a rule, in our country many small cities with some suburbs and municipalities will fall into this category.

This territory if not located within the closest suburbs of the Moscow or St. Petersburg agglomeration has worn-out power networks. In fact, in some regions the equipment is from around the time of the 1917 revolution. Such technical deterioration is not acceptable. Territorial administrators are definitionally obliged to provide citizens with energy and heat. However there are not enough immediately available funds renovate assets, and sadly they can't afford one single modernization. Thus power engineers and owners of power assets very carefully use old equipment with no rush to remove it from the grid.

The key element in our hypothetical case is the power plant which produces heat and energy. In consideration of its modernization we face one more "stakeholder" - the producer of power - raw materials. In our case, given the availability and price, it may be optimal to consider using natural gas. Gas-producing companies clearly desire additional consumers in increase their markets and Russia can benefit from the internal economies created as well. (Just for informational purposes – at present it is believed that in Russia more than 1/3 of houses and smaller power plants do not use gas in Russia).

On the other hand, in addition there is political capital to be gained by a reduction in energy prices for the general population overall. We believe that the most acceptable resource for this purpose is the modernization of a heat power complex with an increase on tariffs for raw materials.

Understanding that at adoption of the federal program on modernization of a power complex plants of the corresponding profile will be loaded, but also new will begin being under construction, there are "stakeholders" in the person of investors, owners and large industrialists. Assuming necessary funding, all of these plants will be updated gradually and by the time they are completed it will be necessary to modernize the "first" thermal power plants. Such cyclical demand will provide stable economic growth and create highly skilled workplaces.

It appearrs at first blush, that this is a win-win for everyone. But at first sight all interested parties receive the benefits, but there are hypothetical opponents as well.

The question becomes whether to buy the cheaper equipment from Siemens or build the plants ourselves with our own R and D (research and development). Despite the initial potential benefits by using Siemens, a decision to use their resources negates most benefits because they would now be received by a foreign producer.

Another weak point in a project such as this could be a position taken by the large network players who will actually monopolize the market. All the large and profitable assets would belong to them, and they will not be interested in non-performing assets. Bluntly speaking, there is less of an opportunity to steal or launder money during small projects. It is quite possible to overcome corrupt activity only through an administrative resource and political will. At the same time, new legislation comes into effect under No. 261-FZ regarding "energy saving and power efficiency increases via the modification of certain legislative acts of the Russian Federation". This legislation differentiates the powers of public authorities of the Russian Federation and the constituent entity of the Russian Federation in the field of energy savings and increased power efficiency, determined by a number of key requirements and terms from performance and action.

Energy audits will allow objective data on the volume of consumed energy resources, define indicators of power efficiency and energy saving potential, and also to develop a list of standard, public actions for energy savings and their cost assessment. This is an important step of innovation for power engineers.

Today, however it is difficult to distinctly answer the question to whom is the economy of energy personally favorable? The main problems are the withdrawal of the budgetary and tariff processes.

As such, energy carriers' motivation may not be to increase efficiencient energy use, but rather merely a justification of further growth of tariffs or additional requests for the budgetary financing.

It will be necessary to sort through the financial mechanisms of implementation. With present conditions of deficient territorial budgets there are only two real mechanisms:

1. direct loan at financial institutions or the grant of the federal center,
2. equipment leasing.

In the second case territorial bodies of authority and management are able to distribute modernization costs evenly over the entire period of use. Standard modern stations with power up to 30 MWt, with mass production of the equipment for the payback period according to the scheme of leasing will take no more than 7 years. And the useful term of use without loss of power and efficiency is about 11 years. Leasing gives a rather high payback of the project. We consider that leasing could be a possible addition to the tool of a bonded power loan to the general population to which it would be offered as an investment in the accumulation of power network modernization. Issued bonds can be provided.

Another important aspect to be considered in this activity are the legalities. Legislation can set network restrictions on power for energy producers to keep large players from occupying and monopolizing the market.

Modification of regulations and actual liberalization of market power production at regional level will allow power supply issues for the territory to be resolved independently.

In conclusion we emphasize that in the continuing world crisis it is the extremely important to increase and preserve domestic power production. This ensures the key factor of economic sovereignty. The Russian power system - one of the world's largest, can have a serious impact on the power balance on both a regional and global scale. The present model of the power market doesn't suit the Russian Federation because of its gross inefficiency. A new system developed by the Ministry of Energy hopes to increase the investment appeal of this branch. 30 years ago only very large industrial plants if they didn't like price on electricity, could make the decision on a huge investment to construct a power plant, with heavy investment. Today however, thanks to technological development, it is possible to build own generation, avoiding centralized power supply. It is available for an increasing number of consumers. Power system development via these modern technologies initiataes innovation across multiple spheres and will create the impulse for modernization of our domestic national economy. State modernization of our national power complex becomes the first and important step along this path.

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About the Authors

Alexey Ilyin, North-West Institute of Management – branch of Russian Presidential Academy of National Economy and Public Admnistration, Russia

Dmitry Makhnev, North-West Institute of Management – branch of Russian Presidential Academy of National Economy and Public Admnistration, Russia

Valery Yanovskiy, North-West Institute of Management – branch of Russian Presidential Academy of National Economy and Public Admnistration, Russia

Improving Communities' Resilience through Geospatial Information Utilization

Daniel Bolaños Gonzalez, International Federation of Red Cross and Red Crescent Societies, Kenya

Abstract

The International Federation of Red Cross and Red Crescent Societies (IFRC) has embarked on an initiative to use Geographic Information System (GIS) data to improve Red Cross Red Crescent National Societies' capacities to measure and track resilience in target communities. This Resource Management System (RMS) is targeted to Red Cross and Red Crescent National Societies and the IFRC Secretariat with the overall aim of supporting the daily management of material and human resources and of informing the planning of both disaster operations and longer-term programming. The system allows users to geographically map and identify vulnerable regions and communities through the use of census, hazard and vulnerability data, alongside plotted data of the Red Cross Red Crescent National Societies' human and material resources. The RMS has been built drawing from free open source software called "Sahana Eden", therefore, existing as a platform that could be implemented across National Societies.

As part of further development and expansion of the system, IFRC has created a vulnerability module, which will allow Red Cross Red Crescent National Societies conducting Vulnerability and Capacity Assessments (VCA) to define and geographically map multiple aspects of target communities' vulnerability and resilience indicators. The new module is planned to be piloted and tested as part of the IFRC Urban Disaster Risk Reduction Programme in Africa, amongst other opportunites for piloting. Through the utilization and sharing of the information generated in this module amongst key stakeholders, including governments and other humanitarian actors, the RMS can facilitate more effective disaster risk reduction planning and programming, as well as more precise targeting of the most vulnerable communities.

Keywords

International Federation of Red Cross and Red Crescent Societies (IFRC), Red Cross Red Crescent, Resource Management System (RMS), Geographic Information System (GIS), Disaster Risk Reduction

Introduction

The International Federation of Red Cross and Red Crescent Societies (IFRC) is the world's largest humanitarian organization, with 13 million volunteers and reaching approximately 150 million people around the world (IFRC 2013). IFRC is comprised of 189 Red Cross and Red Crescent member National Societies, which serve as auxiliaries to their governments and typically have quite comprehensive geographical coverage in their respective countries. National Societies, IFRC and the International Committee of the Red Cross make up the International Red Cross and Red Crescent Movement. IFRC works in multiple different programmatic areas, guided by Strategy 2020, which focuses its work on disaster response and recovery, development and the promotion of social inclusion and peace (IFRC 2010).

IFRC has worked on the development of a Resource Management System (RMS), which for the first time, offers Red Cross and Red Crescent National Societies the ability to view and analyze hazards and vulnerabilities, alongside their National Society's material and human resources on digital maps, in order to examine levels of preparedness and response capacities. The RMS network is hosted on a cloud and able to display Web Map Service (WMS), Web Feature Service (WFS), GeoRSS, GeoJSON, Keyhole Markup Language (KML), Open Street Map (OSM) and ArcGIS shapefiles. Through the use of the RMS, the Red Cross Red Crescent aims to be better equipped in disaster operations and development efforts by integrating resource management into one compatible and comparable database maintained by those staff members at the National Societies who directly use and manage the specific data. By analyzing data on maps, the RMS enables users to better identify vulnerable communities and subsequently serves as a tool to inform National Societies' programmatic planning and support, disaster response operations, and organizational development.

Figure 1: RMS main page, displaying the various available modules.

Initially, the RMS centered on serving as a disaster management tool. However, the system has expanded to support additional sectors, including health, water and sanitation, logistics, and human resources and administration, thus becoming a more comprehensive programme planning and management tool. The RMS is an integrated, web-based GIS that contains various components to assist in areas of information and resource management, including modules specific to staff, volunteers, members, warehouses and assets within and as part of the National Society. The system also includes modules specific to project tracking and assessments, which can display more fully where and how the National Society has been involved in particular geographic regions. Over the past year, a module specific to vulnerability and resilience measurement and tracking has been developed as part of the RMS. Its rollout is aimed at improving Red Cross Red Crescent National Societies' ability to map resilience levels of vulnerable communities in order to appropriately and adequately target and implement interventions, as well as offer an opportunity for information sharing amongst stakeholders and partners involved in disaster risk reduction initiatives.

Data from Timor-Leste 2010 census.

District	Population						Households			
	Total	Male	Female	Sex	Area in	Density	Private			Other
							Total	Male Headed	Female Headed	
TIMOR LESTE	**1,066,409**	**544,198**	**522,211**	**104.21**	**14,954**	**71.31**	**184,652**	**155,118**	**29,534**	**1,342**
AINARO	**59,175**	**30,183**	**28,992**	**104.11**	**870**	**68.03**	**9,664**	**8,155**	**1,509**	**128**
AINARO	**15,558**	**8,083**	**7,475**	**108.13**	**236**	**65.94**	**2,292**	**1,949**	**343**	**108**
Ainaro	6,937	3,640	3,297	110.40	31	225.61	871	702	169	105
Suro-Craic	1,088	580	508	114.17	28	39.03	182	166	16	1
Soro	1,861	931	930	100.11	28	65.34	299	247	52	2
Manutasi	1,704	902	802	112.47	18	95.50	265	227	38	0
Cassa	2,495	1,267	1,228	103.18	70	35.65	414	368	46	0
Mau-Ulu	470	246	224	109.82	27	17.20	89	80	9	0
Mau-Nuno	1,003	517	486	106.38	34	29.78	172	159	13	0
HATU-BUILICO	**11,950**	**5,978**	**5,972**	**100.10**	**130**	**92.01**	**2,058**	**1,723**	**335**	**5**
Mulo	6,274	3,123	3,151	99.11	45	138.34	1,112	910	202	5
Nuno-Mogue	3,394	1,701	1,693	100.47	33	101.38	542	470	72	0
Mau-Chiga	2,282	1,154	1,128	102.30	51	44.70	404	343	61	0
MAUBISSE	**22,022**	**11,188**	**10,834**	**103.27**	**261**	**84.39**	**3,604**	**3,018**	**586**	**10**
Maubisse	6,184	3,186	2,998	106.27	22	283.82	974	803	171	8
Manelobas	1,148	575	573	100.35	8	139.70	186	156	30	0
Manetu	2,413	1,213	1,200	101.08	20	120.17	362	323	39	1
Aitutu	4,539	2,301	2,238	102.82	47	96.76	767	635	132	0

Same information displayed on a map.

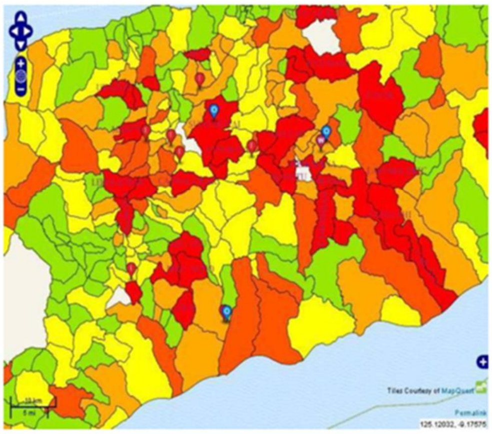

Figure 2. Example of data imported onto map of sucos divisions in Timor Leste, displaying access to safe water sources. Such geographic displays can directly inform needs and help to determine locations for water and sanitation projects.

Methodology

The development of the RMS was initiated in IFRC's Asia-Pacific zone at the end of 2010, upon the request of Red Cross Red Crescent National Societies in this region. The key design paradigm has been to make the system user-friendly, so that users would not require specific or in-depth technical or IT knowledge and skills, and to better ensure wide utilization and accessibility. Currently, ten National Societies have piloted and are using the system which include Bangladesh, Malaysia, the Maldives, Micronesia, Mongolia, Myanmar, the Philippines, Timor-Leste, and Vietnam (to receive training and pilot the system starting in February 2014). More than 20 additional National Societies have expressed interest in planning to implement the system over the next year across the Africa, Americas, Asia-Pacific and Middle East and North Africa zones. In Africa, for instance, IFRC has reached out to multiple National Societies to present the potential support that the RMS could provide, and to determine needs and capacities to implement such a system.

Given the RMS' integrated approach, the system offers an opportunity for information sharing across various departments and offices within an organization, from National Societies' headquarters to local branch offices. This helps to consolidate information, reduce duplication map resource capacities and gaps, and facilitate efficiency to collect, analyze and share data that supports operations and programming towards supporting vulnerable communities. As part of IFRC's rollout of the RMS, National Societies typically prioritize and self-select the modules (staff, volunteers, members, assets, warehouses, project, assessment) to pilot within their organization, relevant to their focus areas of work and expertise, and that can complement or fill gaps in data management. It is recommended that one to two modules be piloted initially, and that they be implemented first at the National Society headquarters and across one to two additional branches.

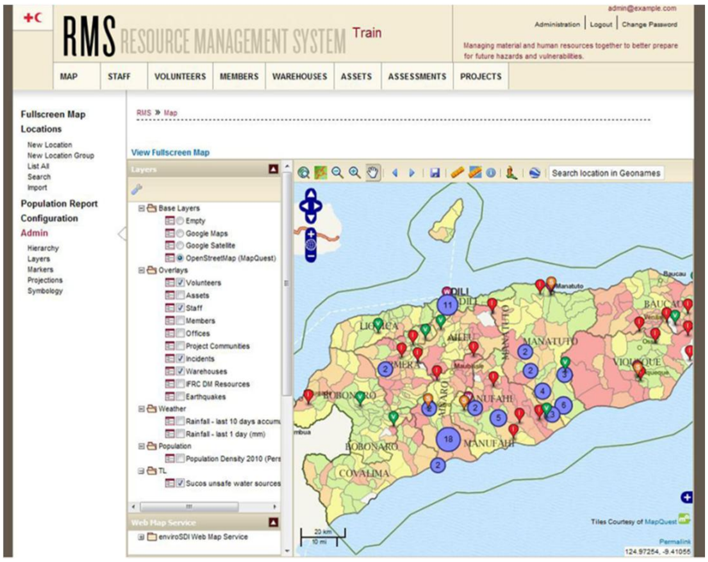

Figure 3. RMS screenshot showing multiple module layers open, including volunteers, staff and warehouses, superimposed onto a map displaying sucos divisions of Timor Leste and varying levels of unsafe water sources.

For each country where the RMS is piloted and implemented, Red Cross Red Crescent National Society must prepare by identifying and formating the existing data available and applicable to be imported into the RMS, based on the selected modules to be implemented. A training of National Society staff and volunteers, as applicable, is conducted specifically focused on their selected priority RMS modules. IFRC has developed a training package and user guides to facilitate these workshops, and offers technical support while the system is piloted in the National Society. To better ensure sustainability, integration into National Societies' longer-term planning will support the institutionalization of the system.

As part of expanding the RMS, an additional module, focused on aspects of vulnerability and resilience measurement and mapping, has been developed (in collaboration with Parsons The New School for Design) to further support National Societies' work, specifically centered on elements of disaster risk reduction and disaster management. This vulnerability module, as currently referred to, offers an opportunity for Red Cross Red Crescent National Societies to measure, map and track levels of vulnerability and resilience across and within target areas. Through the Red Cross Red Crescent's methodology for conducting programmatic assessments, National Societies lead Vulnerability and Capacity Assessments (VCA). These assessments draw on leading multiple, multi-sectoral participatory tools with an array of community members, which help to subsequently evaluate communities' and people's exposure to hazards and their capacities to resist such hazards. The VCA help to ensure that disaster risk reduction and preparedness programming is community-based, such that priorities and capacities are identified, designed and planned with the target communities.

From the VCA process, findings and results are typically compiled into a report - oftentimes, rendering it complicated to compare across communities and difficult to create a comprehensive overview of various communities' capacities and vulnerabilities in one document. The RMS' vulnerability module, however, aims to allow comparative data to be more easily viewed over geographic space and time, based on the ranking and comparison of a set of several indicators.

Figure 4. Snapshot of the RMS' vulnerability module, displaying the various functions available, including ranking of specific resilience-related indicators that are then plotted onto the map, and additional census data.

For the piloting of this new tool, the vulnerability module is planned to be tested in various contexts and sectors. Indicators are still under development. Discussions will determine which indicators may be included as global indicators to track resilience, as well as a set of indicators to be tracked on a regional or national level that can capture relevant aspects of the diverse issues faced by various Red Cross Red Crescent National Societies. Guidance on how to determine the rankings for each indicator, defining numbers and quantifying findings from the VCA for the various vulnerability indicators, will also be developed.

As part of the testing, the vulnerability module is anticipated to be piloted for use in urban contexts. According to the World Health Organization, more than one half of the world's population lived in urban settings as of the year 2010, and the projection for 2050 is that it will grow to 70 per cent (World Health Organization 2014). IFRC has historically supported disaster relief and preparedness efforts, predominantly in rural communities. However, recognition has grown in recent years that urban and suburban areas are not just places where economic opportunity is growing and thriving, but are also increasingly places where vulnerability and risk are growing as well. This is due to several factors, including climate changes which are affecting hazard patterns and subsequently altering traditional coping mechanisms; and population growth and urbanization which is increasing exposure levels, as more people seek shelter and livelihoods opportunities in urban settings, often in marginal areas with high relative exposure to natural hazards.

Given the growing need and acknowledgment of vulnerabilities in urban contexts, IFRC plans to test the vulnerability module alongside its Urban Disaster Risk Reduction (UDRR) programme in Africa. The impacts of climate change are distributed unevenly within urban populations, with low-income groups often being particularly vulnerable due to their greater exposure to hazards and their lower levels of adaptive capacity. A focus on building communities' resilience to cope with the growing uncertainty of urban risk to natural hazards is becoming more important for protecting the lives and livelihoods of urban residents. IFRC has thus embarked on the UDRR programme across nine cities in Africa, aimed at tackling urban vulnerability and strengthening resilience of urban communities. The goal of the UDRR programme is to achieve strengthened community capacity to prepare for and respond to disasters in their urban contexts. By the close of the programme, it is anticipated that communities will be more aware of the present and future risks and hazards in their urban areas and will be better equipped to respond, should those hazards result in disaster. The participating cities in the programme are the following: Abidjan, Cote d'Ivoire; Addis Ababa, Ethiopia; Dakar, Senegal; Dar es Salaam, Tanzania; Harare, Zimbabwe; Kampala, Uganda; Lilongwe, Malawi; Nairobi, Kenya; and Yaoundé, Cameroon.

Although GIS has existed for more than three decades, its benefits and contributions are still oftentimes not fully and widely understood amongst humanitarian and other actors working on urban risk reduction. There still exists a considerable need to promote a more effective use of GIS in urban disaster risk reduction efforts and to facilitate more open exchange of geospatial information, which can subsequently reduce overlapping efforts amongst stakeholders, while also improving the efficiency and effectiveness of disaster risk reduction efforts in urban contexts. The vulnerability module, and the RMS more generally, therefore contribute to IFRC's Strategy 2020's aim to 'build new capacities, promote innovation in social mobilization and harness new knowledge and advances in communications and technology. This will enable us (Red Cross Red Crescent Movement) to operate on the much greater scale that is necessary to meet the needs and vulnerabilities that we should tackle, given our overall size, reach and potential' (IFRC 2010, p. 9).

Though most countries possess a wide range of geospatial information of their territories, this information is oftentimes not easily understood by many city planners, policymakers and humanitarian actors due to the data's specialized form and the expertise required to comprend and work with it. Access itself to the geospatial data, however, is rarely restricted. It has also been recognized that datasets relevant to urban disaster risk are frequently scattered across multiple information systems that are hosted and maintained by different organizations. This often creates, in essence, information silos and causes inefficiencies in information exchange across various stakeholders. One of the key recommendations to improving this challenge is the provision of tools to key stakeholders which are easy to use and that offer extensive support for the import and export of data in multiple and different formats, which can reinforce interoperability and can offer more comprehensive utilization of geospatial data across different organizations. Through the use of the vulnerability module, it is anticipated that Red Cross and Red Crescent National Societies will be able to measure and track vulnerability levels in targeted areas, such that this information can be shared with stakeholders to complement each other's work in these communities.

Through the UDRR programme, Vulnerability and Capacity Assessment (VCA) exercises have been completed in the nine participating cities in Africa. National Societies selected multiple tools from the VCA toolbox[1] which they deemed relevant and had experience in conducting. For several Red Cross and Red Crescent National Societies, the UDRR programme is their first experience in disaster risk reduction efforts based in urban contexts, given the Red Cross Red Crescent's longstanding work in rural settings. The VCA process thus allowed for analysis and modification of certain tools and questions, so as to be more appropriately relevant to the urban context. Findings and results from these VCA tools will contribute to completing the RMS' vulnerability module indicators and guidance under development.

Results

Following the piloting and implementation of the RMS in ten Red Cross Red Crescent National Societies, several lessons learned have emerged from these experiences in various contexts. Some of these lessons include the following:

- Information management systems and procedures are often ad hoc and are not consolidated. The RMS, therefore, offers an opportunity to strengthen and merge processes so as to better contribute to organized and systematic maintence and management of information across locations, such as from headquarters to branch offices.

- One of the RMS' advantages is the provision of operational support for multiple Red Cross Red Crescent National Society core activities. When additional modules are made available, greater acceptance and adoption can be facilitated within the National Society by the already on-going use of the system, as staff become more efficient with the RMS, given their exposure to and use of the system. In addition, the value of the system as a management tool increases as

[1] The VCA toolbox with reference sheets can be accessed at: http://www.ifrc.org/Global/Publications/disasters/vca/vca-toolbox-en.pdf.

the volume of data maintained and managed within the database expands, thus growing synergies across sectors and departments, as well.

- Although the volunteer module has proven the most attractive to Red Cross Red Crescent National Societies, the RMS is now also being displayed as a technical and sectorial resource. For instance, in the Africa zone, the RMS is utilized to disseminate deployment messages to regional disaster response team members, alerting members of disaster operations seeking sectorial expertise and support, and offering a method for members to apply for deployment. The RMS can thus serve wider purposes, such as the Pakistan Red Crescent Society's anticipated plans to use the RMS to manage and map its domestic disaster response-trained staff, assets and volunteers. In addition, the Asia-Pacific zone's water and sanitation unit will begin in January 2014 to map its technical resources across the zone, including trained staff, volunteers and assets, through the RMS. Given that one of the main goals of the RMS has been to build the capability to share and disseminate information across IFRC, National Societies and partners, the promotion of modules beyond just the volunteer module will help to demonstrate and utilize the full capacity and value of the RMS.

An evaluation of the RMS implementation with the Philippines Red Cross and Timor-Leste Red Cross will take place in early 2014. Already, one lesson learned from the RMS experience concerns the scale of rollout within a National Society. For instance, the Philippines Red Cross Society chose to utilize the RMS as its volunteer management system. It was deemed that if all information on volunteer trainings, skills, experience and contact information was entered into the RMS volunteer module, the system would offer great value to the Philippines Red Cross and partners. However, due to the scale of the implementation, the size of the National Society and other on-going disaster operations, this proved to be a challenging goal to achieve. In actuality, a portion of the volunteers and their information has been uploaded onto the system thus far, and it is still an on-going task, in addition to ensuring appropriate data quality of the more than 200,000 records in the system. The recent disaster in the Philippines, Typhoon Haiyan, affected provinces that had yet to implement the RMS, which therefore, were not in a position to benefit from the comprehensive volunteer information that the RMS could provide.

Results and lessons learned from the new vulnerability module are still to be determined and compiled, based on the outcomes of piloting the module in various contexts. Discussions are underway to determine the indicators to be tested as part of the UDRR programme, potentially adopting several 'global' indicators tracked at a national level, along with another few indicators more specific to the particular urban context. For the urban community level indicators, it is anticipated that Red Cross Red Crescent National Societies will select from a list of indicators that are most appropriate to address the risks and priorities identified as part of the VCA exercises in their specific targeted urban communities.

Conclusion

The benefits of the overall RMS are manifold, including offering contributions to organizational development, and programme development and management. The system allows for information to be more easily shared and organized across National Society's headquarters and branch offices, as well as IFRC. Given the multi-sectoral nature of the system, the RMS allows for integrated operations and programme planning and oversight, as well as greater preparedness for and response to disasters. Data is backed up on a daily basis, thus reducing the threat of losing information. The online system does not present additional costs to National Societies utilizing the RMS, thus a financial advantage. Additionally, the development of new modules and features is guided by the needs and requests of Red Cross and Red Crescent National Societies themselves, further ensuring the relevancy and utility of the system.

As auxiliaries to their national governments and often with comprehensive coverage and access to communities through their wide networks of volunteers, Red Cross Red Crescent National Societies are well placed for collecting information on vulnerabilities, capacities and resilience. This extends also to urban communities, where the Red Cross Red Crescent is further expanding its work and efforts. In order to make a real impact on the lives of the most vulnerable, accurate and more extensive information should be shared openly amongst key stakeholders involved in urban disaster risk reduction efforts. Accessible and easy to use systems should be developed, such as the RMS, in order to facilitate information sharing and utilization. Additionally, the importance of urban disaster risk reduction and the benefits that GIS data offers to risk reduction efforts should be more widely advocated. Through the use of the RMS's vulnerability module, IFRC aims to offer an innovative approach to humanitarian initiatives focused on urban disaster risk reduction through the compilation of community-driven results from the VCA processes that contribute to relevant indicators in the system. In addition, the module allows for the ability to geospatially map these results, so as to improve interventions in targeted communities, ultimately improving communities' resilience.

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About the Authors

Daniel Bolaños Gonzalez, Disaster Management Coordinator for Africa, IFRC, Kenya

User-driven Innovation for Dementia Care in France: The LUSAGE Living Lab Case Study

Maribel Pino, LUSAGE Living Lab, Hôpital Broca, Assistance Publique-Hôpitaux de Paris & Université Paris Descartes (EA4468), France,
Samuel Benveniste, CEN STIMCO & MINES ParisTech, Centre de Recherche en Informatique, France,
Robert Picard, Conseil général de l'économie, de l'industrie, de l'énergie et des technologies (CGEIET), France,
Anne-Sophie Rigaud, LUSAGE Living Lab, Hôpital Broca, Assistance Publique-Hôpitaux de Paris & Université Paris Descartes (EA4468), France

Abstract

The use of technology-based products and services for supporting older adults living with dementia, and their caregivers, has gained significant popularity in recent years. In this paper we present the case study of LUSAGE, a French Living Lab that has successfully adapted to provide the infrastructure, knowledge and services required to promote user-driven innovation in the context of dementia care by: (a) taking into account the needs and interests of primary end-users (patients, families, and care providers) and relevant stakeholders in the healthcare ecosystem; (b) encouraging the active involvement of primary end-users in all stages of the product design and development cycle, (c) conducting experimentations and assessments in real-life conditions, and (d) fostering value creation including individual, social and economic dimensions. By delivering a complete description of the implementation process and activities of LUSAGE over the last years, we identify factors that have influenced success and failure in innovation in this context. Finally, we suggest some promising directions for further development of Living Labs working in the field of healthcare and independent living.

Keywords

User-driven innovation, dementia care, assistive technology, Living Lab, ecosystem

Introduction

Dementia care is one of the biggest challenges that society faces today. To deal with the increasing number of persons living with dementia (PwD), authorities worldwide are working to improve their treatment and better support caregivers and families in a cost-effective way. This has been an important driver of change in the governance of health systems at the local, national and international scales, resulting in the reconfiguration of responsibilities for health policy, regulation and management (Jakubowski & Saltman, 2013). Part of this reorganization of the field is the progressive implementation of integrated care and case management practices for dementia care in several countries, including France (Koch et al., 2012). These approaches aim to provide a better coordination at the clinical and organizational levels and avoid the fragmentation between service providers (e.g., health vs. social, institutional vs. community based, private vs. non profit and public) (Somme & Stampa, 2011).

Considering that disease-modifying treatments for dementia are unlikely to become available before 2020 (Brodaty et al. 2011), effective non-pharmacological approaches are needed to promote independent living and enhance the quality of life of PwD. Thus, over the past decade, the number of Assistive Technology (AT) products and services aimed to support PwD and their caregivers has largely increased. AT for this population include devices that support carers, such as medication reminders, fall detectors, or GPS tracking devices, along with other technology-based systems aimed at improving the cognitive, social, emotional and physical environment of PwD, like social assistive robots, smart-home solutions, simplified videophones, or digital games for stimulation purposes (Lauriks et al., 2007; Carrillo, Dishman & Plowman, 2009). Far from being a replacement for personal care, these solutions complement the intervention of caregivers and may be used to alleviate their work.

Although limited by the small number of studies published to date, evidence-based findings from the assessment of AT solutions in this context are not only positive (e.g., improved quality of life for PwD and their carers, reduction of care costs, increased safety at home) but provide support for further development of these interventions (Buettner, Yu & Burgener, 2010; Carrillo et al., 2009). Nevertheless, despite their proven usefulness, several barriers still hinder the wide deployment of AT for dementia care including: technology acceptance and usability issues, the lack of public awareness on existing solutions, reliability, scalability and interoperability problems, uncoordinated or inadequate funding, and difficulties to balance the interests of multiple stakeholders, end-users in particular (Nugent, 2007; Pino et al., 2014).

In this paper we present the case study of LUSAGE, a Living Lab (LL) created to investigate these factors and help stakeholders create effective solutions that would actually penetrate the market. LUSAGE is based in Paris (France) and is affiliated to both a public hospital (Broca Hospital, Assistance Publique-Hôpitaux de Paris) and a public university (Paris Descartes University). Since 2005, LUSAGE has been involved in more than 20 national and European projects dealing with the design, assessment and provision of AT for PwD. After providing an overview of the reasons behind the development of this LL, we describe key enabling and risk factors for this initiative. Then, we explain the implementation process of LUSAGE and deliver a panorama of its activities over the last years. Finally, we analyze the main results of the program, summarize lessons learned and identify challenges ahead.

Problem

The World Health Organization (WHO) estimates that 35.6 million people live with dementia worldwide, a number expected to double by 2030 (WHO, 2012). Dementia covers a group of symptoms including progressive cognitive and functional decline, challenging behaviors and other psychological manifestations (e.g., apathy, agitation, social withdrawal, or wandering), which can seriously compromise independent living at home and in community settings. As a result, effective dementia management includes the provision of regular medical and social services: medication, health monitoring, personal care, caregiver support, and preventive services.

In Paris, the increasing demand for geriatric healthcare services led to the creation of Broca hospital in 1982. Then, in 1994 a Memory Clinic specialized in the diagnosis and treatment of elderly patients with cognitive disorders, due to conditions such as Mild Cognitive Impairment (MCI), Alzheimer's disease (AD), and other forms of dementia, was established within the hospital. In 2002, the department was labeled by the national authorities as one of the Expert Memory Centers of the Parisian region and was included in the EADC (European Alzheimer Disease Consortium), which regroups all the Expert Memory Centers in Europe.

Non-pharmacological treatments for PwD have been a traditional research area at Broca hospital from its beginnings (De Rotrou, 1992, 2011; Wenisch et al., 2007). In fact, the first structured cognitive stimulation program for PwD having showed a significant improvement in cognition and quality of life was developed at the institution (Breuil, 1994). Since the early 2000's the team has also developed and implemented various psycho-educational programs aimed at supporting and training caregivers of PwD (De Rotrou, 2006, 2011). However, two factors appeared to limit the wide implementation of these programs into clinical practice:

a) *The necessity of a regular physical presence of participants*: With the progression of cognitive impairment PwD must at some point stop driving and are dependent upon others for transportation. This severely reduces their ability to attend the sessions. Also, when an informal caregiver is available, which is not always the case, finding the time to attend face-to-face meetings can be challenging, being often overwhelmed with managing his/her daily tasks and responsibilities;

b) *Financial and human resources required for their creation and delivery*: In Broca's Memory Clinic 4500 patients consult per year and 2500 are followed up on a regular basis. Offering these programs to everyone raised the question of availability of trained staff and funding issues.

With the arrival of telehealth and the generalization of Internet use, healthcare professionals from Broca decided to explore the potential of Information and Communication Technologies (ICTs) to deliver these interventions. The major goal was to optimize the provision of care and support programs for PwD and their families by reaching a larger number of recipients at a lower cost. That's how TANDEM, the first collaborative research project on gerontechnology at Broca, began in 2005.

TANDEM aimed at studying the acceptance and usability of an integrated system to provide PwD with computer-based cognitive stimulation and other functionalities. The solution was intended to play the role of an additional caregiver (Rigaud et al., 2010). A consortium of partners from different academic institutions and an SME was created for this purpose. Broca's professionals used their clinical expertise, some questionnaires and informal discussions with PwD and their caregivers to establish the specifications for this system. After conceiving a proof of concept, a seasoned ICT firm was commissioned to develop a functional prototype.

The system created did not entirely respond to the needs of end-users, mainly because of usability issues. Also, the project failed to reach technical maturity, essentially because of integration and interoperability issues. However, the experience was informative as it allowed the identification of factors regarding human computer-interaction in PwD and older adults with limited technology experience. General conclusions drawn from this experience were:

- Little was known about the use of AT to support cognitive functioning.
- Needs of PwD are very heterogeneous and changing, meaning that developing AT for this population requires a thorough and multi-dimensional assessment of their individual situation and iterative testing of AT solutions.
- Understanding the interaction of PwD with AT is only possible through direct and extended observation.
- AT acceptance by PwD and their caregivers is influenced by several ethical, psychological, and socioeconomic factors.
- Older adults are willing to use AT solutions, and get satisfaction from doing so, if products are tailored to their needs and abilities, so AT is a promising field in geriatrics.

Gradually, Broca hospital was acknowledged as an expert "end-user organization" by research and industry partners working on AT for older adults and thus, took part in several regional, national and European AT projects from 2005 to 2009 (Table 1). The multiplication of research activities related to gerontechnology led to the conclusion that it was necessary to create a more structured framework for conducting the tasks normally assigned to end-user organizations (e.g., needs assessment, usability testing, clinical validation). Thus, it was proposed to create a LL, a concept that was understood at that time solely as a physical infrastructure to conduct formal usability testing with potential end-users under controlled conditions.

General Context

Several factors contributed to the maturation of the LUSAGE LL project including:

(a) The implementation of a national dementia strategy by the French government to stimulate investment and innovation in dementia research, prevention, and care.

So far three Alzheimer's disease strategies have been implemented in France. The third one, "Plan Alzheimer", ran from 2008 to 2012. It was structured around three objectives: (a) improving the delivery of health and social care services for PwD and their caregivers through the implementation of an integrated care model and effective support programs; (b) supporting research on early diagnosis, pharmacological and non-pharmacological treatments; and (c) improving the quality of the information provided to patients and their relatives and raising public awareness about the disease (Chevreul, Durand-Zaleski, Bahrami, Hernández-Quevedo, & Mladovsky, 2010).

The "Plan Alzheimer" specifically recognized the opportunities offered by ICTs to support independent living and improve the quality of life of PwD and their caregivers (Ministry of Social Affairs and Health, 2008). Consequently, a budget of 4 million euros was allocated in 2009 to fund multidisciplinary national projects on home automation and AT. This initiative was coordinated by two key public actors: the National Agency for Research (ANR), tasked with funding scientific research, and the National Solidarity Fund for Autonomy (CNSA), responsible for providing financial aids for long-term care for older adults and people with disabilities. The program also supported the creation of a national reference center for the study of ethical issues raised by dementia care. The Center for Ethical Reflection on Alzheimer's Disease (EREMA), established in 2010, has since then examined ethical, legal, and social issues related to dementia care, such as decision making and capacity to consent, respect for autonomy, management of complex cases, end of life, and the adequacy of care and support for PwD and their carers, in particular the use of AT (Ankri & Van Broeckhoven, 2013).

(b) Policies at national, regional and local levels sustaining a wider development and use of ICTs to support the delivery of health and social care services.

The continuing support given to the sector of ICTs for health and social care over the last decade incited the development of LUSAGE. During this period, several public organizations have established funding programs to support clinicians, researchers and manufacturers, working in the sector. Prominent examples are the "National Network for Healthcare Technologies" (RNTS, 2000-2005), and its substitute "Technologies for Health" (TECSAN, 2006-2013) through a partnership between CNSA and ANR. The TECSAN program, endowed with a budget of 13-17 million euros per year, largely contributed to enhance the competitiveness of research organizations and businesses in the healthcare field and played a pivotal role in the implementation of the "Plan Alzheimer".

In the private sector, innovative businesses also benefited from national policies coordinated by the National Strategy for Research and Innovation (SNRI), including: support for business R&D through indirect and direct funding (e.g., research tax credit, OSEO innovation agency), public investment programs (PIA), support for knowledge transfer between public research bodies and businesses (in particular SMEs), and technological and industrial partnerships through the introduction of the Competitiveness Cluster policy in 2004 (OECD, 2012).

These policies have also resulted in the creation in 2009 of a National Reference Centre for Health and Independent Living (CNR Santé) by the Ministry of Economy, Finance and Employment. Some of its missions are: to stimulate the development and proper use of ICTs for health and social care at home, raise awareness among relevant stakeholders, end-users and citizens on the interest of these technologies, build and disseminate solid and standardized methodologies for the development and assessment of healthcare ICTs, provide a regulatory framework and supervision for projects in this area. The CNR network comprises a central structure and various thematic Expert Centers throughout the country (robotics, mobility, cognitive stimulation, housing, etc.).

The recognition of the economic potential of the healthcare technology sector has also led to stimulate greater investment and innovation, at a local and European levels, with actions such as the creation of the "Silver Economy" Initiative by the French government (Ministry of Social Affairs and Health, 2013), the "European Innovation Partnership on Active and Healthy Aging" (EIP AHA), and the EU Framework Program for Research and Innovation "Horizon 2020" (European Commission, 2012, 2013), which particularly encourages the deployment of innovative and user-led pilot projects to support independent living in older adults with cognitive impairment through technology-based interventions. Globally, these strategies are intended to support healthcare innovation, earn the confidence of users and carers, improve their quality of life, promote active aging, and develop the market.

(c) The increased recognition of the benefits of user-driven innovation.

Multiple studies describe the advantages of actively involving end-users in the development and evaluation of healthcare technologies, a process called User-driven Innovation (Von Hippel, 2009); "actively" must be understood in the sense of co-creation and not only as the interaction of the user with the new product/service under development (Picard, 2010, 2011). Shah & Robinson (2007) conducted a literature review on this topic and found that the most commonly observed benefits of this approach are the generation of ideas by users, having direct access to users' perspectives, and the improvement of product design, functionality, usability, and quality. Of course, the authors also pointed out some drawbacks of this practice, such as the difficulty of recruiting a representative group of end-users and time and cost factors. Still, they concluded that the trade-off remains positive because it benefits both users and manufacturers. On the one hand, users have access to technological products that really meet their expectations. On the other hand, manufacturers increase the marketability of their products and services.

That is why many funding bodies have incorporated requirements for the implication of end-users in their funding schemes for AT projects. The most prominent example is probably the Ambient Assisted Living Association[1], which has since its inception required that at least one end-user organization be part of technological projects to ensure that innovative solutions respond to actual user needs. Similarly, at the national level, most private funding bodies, which are usually non-profit organizations (e.g., France Alzheimer, Fondation de France, Fondation Médéric Alzheimer), require that proposals adress user empowerment, referring to the beneficiaries' ability to influence the project (e.g. be involved from the very start and have a real say in decisions).

This trend also goes beyond technological innovation: the search for ways to better take into account the expectations of the users of healthcare systems in the areas of information, rights, choice, complaint procedures, safety and involvement has been an important issue of public debate. In France a pivotal act on the Patients' Rights and Quality of Care was passed in 2002 (Act no. 2002-303 of March 4th 2002). This Act defined: requirements of solidarity towards disabled people; principles of health democracy (in particular, the rights and duties of patients and health professionals); quality requirements of the healthcare system; principles for compensating victims of health hazards; and professional liability. It also further developed the role of patient associations, allowing them to act as patients' representatives, sitting on hospital boards and participating in regional and national health conferences (Chevreul et al., 2010).

Overall, LLs are now considered a key tool for the implementation of this 2002 law, as they encourage health institutions to integrate patients' views when planning care strategies. This results in more appropriate responses to user needs and reduces deployment costs, making it much easier to

[1] http://www.aal-europe.eu/

go from implementation to adoption. It also broadens the application of the LL methodology beyond its traditional technological focus, to the design, implementation, and iterative refinement of organizational or even regulatory innovations.

(d) The establishment and development of local and regional LL networks

Nowadays, the LL approach tends to spread in the industrial sector, and in many research laboratories, at various territorial levels (e.g., local districts, cities, regions) (Picard, 2010, 2011). Their recognition as initiators and catalyzers of change and cross-border collaborations in different systems (e.g., healthcare, urbanism, public services, manufacturing) explains why LL networks have gained increased visibility in the local and regional contexts (Eriksson, Niitamo, & Kulkki, 2005; Schaffers & Turkama, 2012). At the international level, the European Network of Living Labs (ENoLL)[2] has largely contributed to the formalization of the LL concept. Created in 2006 as an international, non-profit, independent association of benchmarked LLs, ENoLL supports the creation of a dynamic, multi-layer and multidimensional European Innovation ecosystem, and facilitates cooperation between members and external stakeholders. It now counts more than 340 accredited LLs all over the world.

At the national level, the French Forum for Autonomy and Health (FFAH)[3] aims to federate the LLs operating in the field of health. It is one of the outcomes of a working group on LLs in the sector of health and independent living, coordinated by the High Council for Economy (CGEIET, 2009-2011) in partnership with the Ministry of Social Affairs and Health. Participant LLs and related organizations joined in 2012 in an informal forum, the FFAH, to federate local initiatives and foster greater collaboration between LLs and other stakeholders. FFAH allows its members to mutualize equipment and cohorts, share knowledge, and exchange best practices to converge towards common, validated and eventually standardized methods and outcome indicators. Issues addressed are specific to the health sector and include: the ecosystem, business models, organizational and ethical aspects, laws and regulations, service interoperability, and evidence dissemination. More generally, FFAH enables LLs to make themselves heard more effectively in the public debate and help raise awareness about their work, especially how it goes beyond experimentation in home-like laboratories and aims to assess solutions in the real world.

The FFAH is now implementing a coordination process with France Living Labs[4] (F2L), whose aim is to develop a network of French LLs in the different sectors of the economy, representing the French chapter of ENoLL.

Enabling Conditions & Risk Factors

Broca hospital directly benefited from national policy reforms pertaining to the care of older people, dementia strategies, and the use of ICTs for healthcare, as well as from the increasing proportion of public and private funds allocated to these sectors. For instance, the team was able to participate as coordinator or partner in different projects funded under the thematic programs RNTS and TECSAN, and was designated as host institution for the National Expert Center in Cognitive Stimulation (CEN STIMCO) by the CNSA. Furthermore, Broca's active engagement in the use of non-pharmacological approaches for dementia care, in particular the use of AT to support patients and carers, allowed the organization to build a reputation for its scientific expertise and social and ethical involvement.

Creating a LL seemed appropriate to keep the momentum gained through all these activities, as well as actively participate in the global effort of the national health system to open up towards citizens and develop home care, which requires innovative yet reliable field-tested solutions. Furthermore, in the case of PwD, whose care raises specific ethical issues, it was clear that such a LL could only exist in a public setting, as no privately run initiative would have the legitimacy and neutrality necessary to undertake such activities with enough confidence from the public.

Nevertheless, some risk factors to the development of this initiative were identified, such as: inadequate funding, lack of cooperation between

[2] http://www.openlivinglabs.eu/
[3] htttp://www.forumllsa.org
[4] http://www.france-livinglabs.fr/

stakeholders, inappropriate resources, uncertainty about attitudes towards innovation within a rather conservative public hospital environment, unrealistic expectations about the potential of AT to support dementia care, and the complexity of involving PwD and their caregivers in LL activities.

Solution and Implementation

The official establishment of the Living Lab LUSAGE was possible in 2009 thanks to "France Alzheimer". AP-HP supplied the facilities to settle the LL within the hospital. External funding was used to set up a technical platform replicating a "home environment", enabling the observation of users interacting with different technologies under controlled conditions. Assessment in real-life conditions could be conducted at the different hospital departments, local adult day-care centers, or in the user's own environment.

User Involvement

LUSAGE strives to involve end-users (PwD, healthy elderly individuals, families, and informal and professional caregivers) in all stages of product development; they may participate either occasionally or in regular user-groups. PwD are recruited from Broca's Memory Clinic, Centers for Local Information and Coordination (CLICs), and local Alzheimer's associations. Healthy elderly persons are recruited through seniors associations. Informal and formal caregivers are recruited through the regional hospital network. End-users that volunteer to participate in LL activities are provided with adapted and comprehensive information about the projects and are required to give written consent for their participation, being free to withdraw from the project at any time.

Evolution of the Project

At its beginnings LUSAGE prolonged the role of "end-user organization" in continuity of the first research projects in gerontechnology conducted at the hospital. This role implied, almost exclusively, the execution of user-research taks: user profiling, needs assessment, iterative development and prototype assessment, and final product evaluation.

Today, LUSAGE studies the factors that influence not only the development and assessment but also the provision and adoption of AT solutions in the context of dementia care. These include micro-level factors, related to individual users (e.g., needs and characteristics, accessibility requirements, individual context of use, perceived value of the solution, individual ethical standards) and macro-level factors, related to a variety of stakeholders and the socio-economic, organizational and infrastructural characteristics of the ecosystem (e.g., public health policies, regulatory issues, quality standards, business models, public-private partnerships, ethical and societal aspects). Thanks to its external position, LUSAGE contributes to bridge the gap between the primary user and the stakeholder network, providing the conditions for technological and social innovation in a win-win situation (Figure 1).

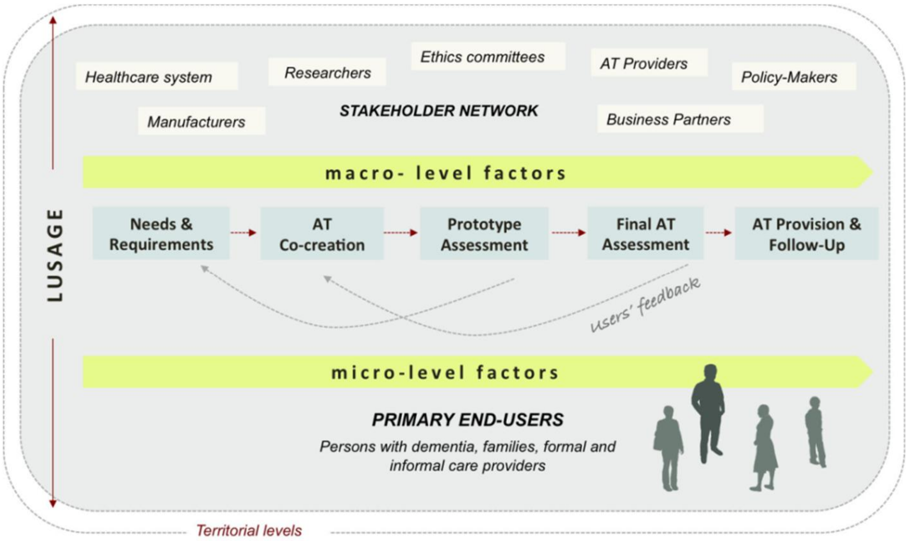

Figure 1 LUSAGE Living Lab Scope and Activities

The evolution of LUSAGE's role is clearly illustrated by the nature of the projects in which it has taken part. Most of the initial projects dealt with AT design and development (e.g., TANDEM, CompanionAble, ROBADOM), while today they include several research topics (e.g., user empowerment, social participation, healthcare policy, stakeholder networks, organizational and ethical aspects, business models, evidence dissemination). For instance, the project "Gerontechnology & You" (2011-2012) aimed to enable older adults to make informed choices regarding the use of AT products and services. By providing a hands-on experience with commercial AT solutions and collecting the views of potential end-users, the team also intended to better understand the ethical issues associated with AT use in old age and design efficient and respectful procurement and training approaches. Another example is the project ITHACA (2014-2016), which studies policy, organizational, and regulatory factors at a local and national levels that may influence the inclusion of AT within individual care plans for PwD. The study also intends to assess awareness among healthcare professionals and end-users of existing AT solutions and provision methods. Results from ITHACA are expected to allow the creation of user-driven, effective dissemination strategies for AT in dementia care.

Ecosystem

The LL approach is based on the endeavor to promote cooperation between stakeholders for the development of valuable and innovative technological products, services, and markets (Bergvall-Kareborn, Hoist, & Stahlbrost, 2009). Therefore, in LUSAGE, primary end-users, large companies or SMEs, policy-makers, research organizations, civic sectors, health insurers, representatives of ethical committees, and other relevant stakeholders, are committed to work together to design innovative AT solutions and participate in experimentations conducted in real-world settings. These collaborations are engaged at all territorial levels (district to international).

Figure 2 presents the ecosystem in which LUSAGE evolves, distinguishing three levels, by order of proximity. The closest level includes actual people directly involved in experiments and other LL activities. They may be affiliated to institutions of the second or third levels, but it is mostly their personal input as primary end-users, early adopters, disruptive innovators or field experts that drives the LL forward. The second level contains institutions that may directly collaborate with the LL in specific projects and occasionally contribute to general LL activities. Finally, the third level includes all the institutions that do not directly take part in innovation projects but indirectly determine the context in which those innovations emerge; LL professionals must reach out to them when necessary to better understand their positions and raise their awareness on issues that demand broad change in terms of infrastructure, regulations, policies etc.

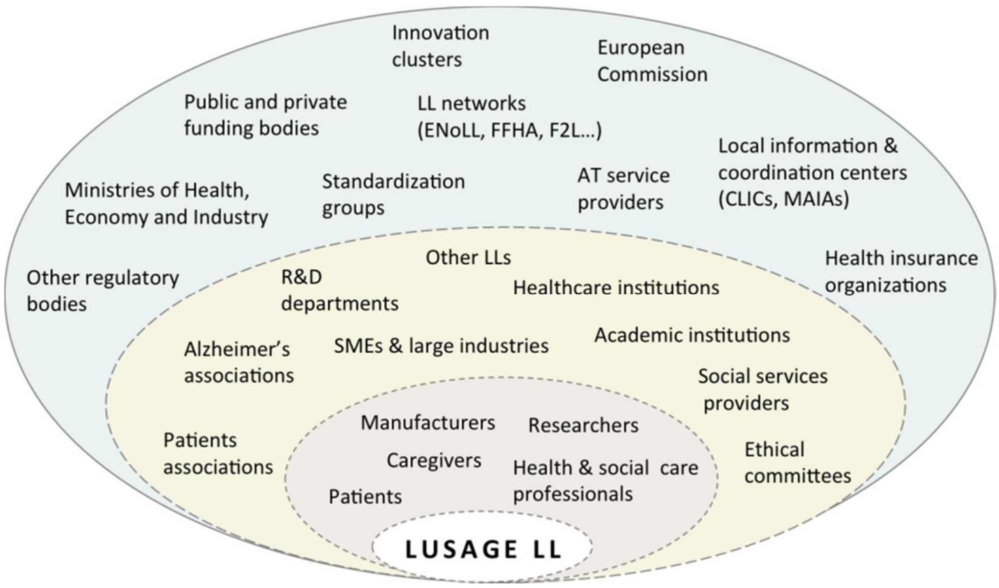

Figure 2 Ecosystem of the Living Lab LUSAGE

Success and Failure Factors

Key success factors for the development of LUSAGE were:

(a) Continuous support received at all levels from policy makers, public and private organizations with stakes in dementia care by means of funding and regulation. Primarily, expected workforce shortages in the field of elderly care has contributed to the decision of supporting research and developpment of AT to ease the burden of informal and professional caregivers.

(b) Creating a highly multi-disciplinary team, involving healthcare professionals with backgrounds in medicine, gerontology, psychology, occupational therapy, and speech-language pathology. Considering that one of the main goals of AT for dementia care is to compensate for cognitive impairment, the team's experience in evaluating cognition and frailty also was a great asset.

(c) The affiliation to a public geriatric hospital, with a long experience in the diagnosis and treatment of memory loss has facilitated the recruitment of primary end-users for LL activities. Approximatley 8000 older adults consult in Broca hospital network per year, making LUSAGE an attractive partner for companies that develop healthcare technological applications and services.

(d) Having a convenient location and offering accessible facilities. LUSAGE is located in the centre of Paris, easy to reach by public transportation and accessible to people using mobility aids. Efforts have been done to ensure that LUSAGE is also accessible and easy to navigate for PwD so they feel confident when visiting.

Some factors that have limited the development of this initiative are:

(a) Short-term, strongly constrained funding, which has often prevented LL-based solutions from panning out into the market. Understanding and taking into account the needs and motivations of users takes time and often leads to reconsider a project entirely. However project regulations require that the entire budget be spent over a determined period (one, two or three years usually), which often prevents teams from incorporating the key insights offered by users through iterative testing. Furthermore, the necessity to explain in detail what the final product will be in order to get funding forces teams to work in a given direction that rarely can be overturned completely, even if end-user inputs reveal that the initial direction taken was wrong, making the principle of "user-driven innovation" less useful.

(b) It is increasingly recognized that the LL approach is particularly adequate for involving PwD, whose needs and capabilities are notoriously difficult to formalize, in innovation activities. However, implicating these users in LL activities is a resource-demanding task that can only be accomplished by properly trained staff. The economic and social value of user-driven innovation within the context of dementia care must thus be better measured and publicized: this will encourage funding/investing bodies to allocate a higher percentage of resources to LL activities within their projects.

(c) No proper business model exists as of today for public sector LLs in the French healthcare system. Indeed, legal and administrative complexities make it difficult to offer a streamlined, industrialized service to innovative solution providers, who are increasingly interested in LLs but are used to working in the simple, flexible framework of the innovation economy. More agile structures at the frontier of the public and private sectors like the non-profit CEN STIMCO, which contracts with industrial partners and then sub-contracts with public sector structures like LUSAGE, are beginning to provide solutions to this.

Results and Impacts

Main economic and societal consequences of the LUSAGE project are:

(a) By integrating end-users' knowledge into AT research and development, LUSAGE has contributed to the design of operational and effective AT solutions for PwD and caregivers, in terms of early acceptance, usability, accessibility, security, clinical effectiveness, and user empowerment. Therefore, these user-driven solutions are expected to gain faster access to markets.

(b) Increasing awareness of the opportunities provided by AT to support dementia care among all stakeholders, including PwD, caregivers, funding bodies, policy makers, and citizens en general.

(c) Through continuous research and experimentation, LUSAGE has developed structured methodologies to involve PwD and their caregivers at the different stages of the design cycle, improving knowledge in the field of human factors/ergonomics. Research findings from LUSAGE have also added substantially to the understanding of the attitudes of PwD and caregivers towards AT, and provided additional evidence with respect to the benefits of AT interventions for dementia care.

Table 1 describes the projects in which LUSAGE has been involved and presents key performance indicators including:

- Total number of projects in which LUSAGE has participated from 2005 to 2014 (n=26).
- Total number of AT-related areas tackled by these projects (n= 6).
- Total number of end-users directly involved in LL activities (evaluations, co-design, training), which includes older adults (PwD, healthy older adults, frail elderly and individuals living with other chronic conditions), informal and formal caregivers (n=1505).
- Total number of industrial partners directly involved in collaborative projects (n= 43).
- Toutal amount of funding received to support R&D and scientific reseach (2 424 773 Euros).
- Total number of dissemination actions (n= 122).
- Membership to LL networks: ENoLL and F2L (2012), FFAH (2013).

Table 1 Description of Projects and Key Performance Indicators for the Living Lab LUSAGE (2005-2014)

Area	**Project** (Territory)	**Description**	**End-users involvement** (Number)	**Final outcome**	**Dissemination channels**	**Funder** (Period)	**Funding received** (Euros)
Tele-health	**TANDEM** (FR)	Integrated support services for OACD living at home, FC and IC	OACD (119), IC (27), HOA (22), IND (1)	Proof of concept Working prototype Guidelines TA/IHM	Papers (6) Conference (12)	Médéric Alzheimer (2005-2007) ANR-RNTS (2006-2009)	50 000 177 320
	Memosyne (FR)	Delivery of CS and support services for HOA	HOA (120), FC (3), IND (1)	Working prototype Guidelines TA/IHM	Papers (3) Conference (2)	DRASSIF (2005- 2007)	50 000
	VASSIST * (EU)	Voice control system for communication and telehealth	OA chronic conditions (46), FC (9), IND (4)	Working prototype Guidelines TA/IHM	Papers (1)	EC- AAL (2010-2013)	119 783
Platform & Networks	**LUSAGE** (Regional)	Set up and furnishing of a LL platform	Multi-stakeholder	Technical platform Guidelines LL methodology	Public events (2) Website (1) Papers (3) Conference (4)	France Alzheimer (2009-2011)	50 000

	CEN STIMCO (FR)	Creation of a National Expert Center on CS	Multi-stakeholder	Consolidation of a stakeholder partnership, guidelines for the assessment of AT for cognition	Public event (4) Website (1) Conference (6)	CNSA Private donation (2010-2013)	350 000 300 000
	ENoLL (EU)	European Network of Living Labs	Multi-stakeholder	Membership (6th wave of certification)	Public events (1) Website (1)	Since 2012	N/A
	FFAH (FR)	French Forum for Autonomy and Health	Multi-stakeholder	Membership	Public events (1)	Since 2013	N/A
	F2L (FR)	France Living Labs	Multi-stakeholder	Membership	N/A	Since 2012	N/A
Social Assistive Robotics	**QuoVADis** (FR)	Development of a social assistive robot to support older adults (PwD, frail OA, HOA) and informal caregivers	OACD (103), IC (30), HOA (28), IND (2)	Working prototype CS software	Website (1) Papers (6) Conference (5)	ANR-TECSAN (2007-2010)	160 800
	CompanionAble (EU)		OACD (80), HOA (28), FC (40), IC (30), IND (5)	Working prototype Guidelines TA/IHM	Website (1) Papers (3)	EC- FP7 (2008-2011)	232 590
	ROBADOM (FR)		OACD (18), HOA (55), IND (1)	Working prototype Guidelines TA/IHM	Papers (4) Conference (2)	ANR-TECSAN (2009)	214 302
	PRAMAD * (FR)		OACD (10), IC (10), HOA (57), IND (2)	Working prototype Guidelines TA/IHM	Papers (1) Conference (2)	Region IdF- FUI (2011-2014)	215 205
	Paro (International)	Evaluation of therapeutic robot for OA with severe dementia	OACD (10), FC (90), IND (1)	Clinical evaluation Guidelines for use	Public event (1) Papers (3) Conferences (2)	AIST (JP) DTI (DK) (2009)	N/A
E-learning	**HCNV** (EU)	Remote training for FC working with OACD	FC (196), IND (2)	Working prototype Guidelines TA/IHM	Conferences (3)	EC – LLP Socrates (2005-2007)	44 406
	ANGELS* (EU)	Augmented Reality for Safety in Healthcare Environments	FC (36), IND (3)	Working prototype Guidelines TA/IHM	Public event (2) Website (1) Conference (1)	EC –LLP Leonardo (2013-2014)	35 261

	DIAPASON (Regional)	Psycho-educational program for IC of PwD	HOA (31), IC (65), FC (15), IND (1)	Working website Guidelines TA/IHM Clinical evaluation	Website (1) Paper (1) Conference (14)	PREQHOS Médéric Alzheimer (2010-2013)	42 000 24 690
AT for Compensation and Stimulation	**T&T Net*** (EU)	Cognitive assistance for navigation	HOA (7), IND (5)	Working prototype Guidelines TA/IHM	Website (1) Conference (1)	EC-AAL (2011-2013)	65 156
	TROUVE* (FR)	Cognitive assistance for item location	OACD, FC, IC, IND (1)	*Expected: Working prototype Guidelines TA/IHM*	*Expected: Papers (3) Conference (3)*	ANR-TECSAN (2013-2015)	105 060
	AVATAC* (Regional)	Virtual agents for cognitive assistance	OACD, FC, IC, IND (1)	*Expected: Working prototype, Guidelines TA/IHM*	*Expected: Papers (3) Conference (3)*	Region IdF (2013-2016)	102 200
	Wii usability* (Regional)	User-tests for the Wii with OA having different cognitive profiles	OACD (12), HOA (12), young adults (12)	Guidelines TA/IHM	Papers (2) Conference (3)	N/A.	N/A.
	Minds (Regional)	Development of a music therapy game for PwD	OACD (40), FC (20)	Final product Clinical evaluation Guidelines for use	Public event (8) Papers (3) Conferences (4)	Charles-Foix gerontech. grant Region IdF-OSEO	12 000 25 000
User empowerment, E-inclusion & Framework for AT Provision	**ITHACA*** (FR)	Framework for including AT solutions in dementia care plans	Multi-stakeholder	Case-study France AT database for dementia care	*Expected: Public event (1) Papers (3) Conference (2) AT database (1)*	France Alzheimer (2014-2016)	50 000
	Gerontechnology and you (Regional)	Promote informed choices for AT through a set of hands-on experiences	HOA (205) INDs (15)	Final report and public event	Public event (1) Newsletter (1) Papers (2) Conference (2)	Fondation de France (2012-2013)	24 000
	Café Multimedia* (Regional)	Promote E-inclusion and social participation through ICTs	*Isolated OA (30-50)*	*Final report*	*Expected: Newsletter (1) Public event (1) Papers (1) Conference (2)*	Fondation de France (2014-2015)	12 000

Total	National (11) Regional (8) European (6) International (1)	OACD =392 IC=97 FC=409 HOA=565 INDs= 43	Websites= 8 Public events= 19 Papers= 36 Conferences= 59		2 424 773

**= Ongoing projects, AAL= Ambient Assisted Living, AIST= National Institute of Advanced Industrial Science and Technology, ANR= National Research Agency, AT= Assistive Technology, CNSA= National Fund for Solidarity and Autonomy, CS= Cognitive stimulation, DRASSIF = Regional Direction for Sanitary and Social Affairs, DTI= Danish Technological Institute, EC= European Commission, EU= Europe, FC= Formal caregivers, FP7= 7th EU framework program, FR= France, FUI= Fonds Unique Interministériel, HOA= Healthy Older Adults, IC= Informal caregivers, ICTs= Information and Telecommunication Technologies, IdF= Ile de France Region, IND=Industrial partners LL= Living Lab, LLP= Life Learning Program, N/A= not applicable, OA= Older adults, OACD= Older adults with cognitive disorders, PwD= Persons with dementia, RNTS= National Network for Healthcare Technologies, TA/HMI= Technology acceptance/Human-Machine Interaction, TECSAN= Technology for Healthcare*

Shared value creation of the initiative and other secondary impacts of the program are:

(a) Knowledge-transfer: Teaching activities related to gerontechnology, AT and dementia care in different educational institutions, corresponding to approximately 1200 hours of teaching in higher and continuing education programs.

(b) Standardization and dissemination : participating in national and European LL networks (ENoLL, France Living Labs, French Forum for Autonomy and Health), LUSAGE has been actively contributing to the exchange of LL good practices related to user-driven innovation in the context of dementia care, the dissemination of evidence and the transferability of effective AT solutions to other localities, regions and countries.

Some Surprising Results

In our experience, older adults, PwD and their families are often willing and able to participate in LL activities. Being a full actor in the process of co-construction of AT solutions improves their self-esteem and their feeling of social inclusion. Furthermore, the presence of a LL within the hospital has contributed to change the views of patients on the role of public hospitals, which become not only providers of care but also a catalyst for user empowerment and social participation.

Lessons Learned and Challenges Ahead

LUSAGE is one of the first European experiments for the implementation of a LL in the context of dementia care; recently, similar initiatives have been launched in this area (Roeg, Snaphaan, & Bongers, 2013). The analysis of LUSAGE activities over the last decade enables us to derive lessons for the replication of the concept:

(a) Establish a stronger link to overall health policies: Innovation in dementia care requires examining how results can be integrated within global health policies and the associated legal, regulatory, and organizational framework. Questions such as: how can the new solutions be integrated into existing models of care delivery? who is going to pay for the new services? how can we ensure sustainability and competiveness of business in the AT sector? and, how can we deal with potential organizational barriers? need to be fully addressed.

(b) The Living Lab as a mediator: LL projects in the field of dementia involve diverse actors (Figure 2); successful innovation is thus highly dependent on effective collaboration between parties. However, establishing a multidisciplinary consortium does not guarantee real cooperation and learning between stakeholders. Thus, the LL has to provide the framework and conditions for actors to benefit from each other, playing the role of mediator. This comprises assisting the parties in the identification and articulation of their own interests, priorities, and needs, and encouraging the definition of agreements and common objectives.

(c) Establish a dissemination plan: A well-designed dissemination plan should ensure that outcomes of LL activities benefit users, stakeholders and society. Thus, developing and implementing timely and effective dissemination strategies towards primary end-users, members of the scientific community, industry, media, policy makers and citizens, is highly recommended. Fortunately, the Living Lab approach is very useful in this regard. Through iterative testing and documention, solutions reach high robustness, and replication from one context to another becomes easier when building on lessons learned from previous efforts.

(d) Innovation within an ethical and legal framework: The LL approach is particularly welcome in the health and social services sector because it allows the integration of patient choices in the design of care solutions that directly concern them, resulting in solutions that better meet their needs, and are less expensive to develop and maintain. But involving PwD in LL innovation strategies requires particular attention to ethical and legal issues. Guidelines governing innovation and research projects should be defined in parallel with the project plan. Local organizations that support PwD and their families can provide information and advice on these topics.

(e) The need for more objective measures of success: The overall positive experience that results from LUSAGE activities is closely related with the high degree of user involvement in the different projects. However the impact of user-driven innovation in the field of healthcare is hard to measure, mainly because it involves multiple factors, for instance: creating acceptable and usable products, promoting social value, supporting user empowerment, improving users' quality of life, generating savings at different levels, or enhancing marketability. Further research is needed to build and test impact indicators for user-driven innovation in order to better understand the value of this approach.

(f) Going beyond design and development: The dissemination of innovations is a major challenge in all industries, including health care. Accordingly, since the begining, LLs have tried to extend their activities beyond design and development and gain a more active role in the provision of AT products (e.g., design of support services and dissemination strategies). However consistent policies and resources are needed for this, as well as greater confidence from industrial partners, all of which will come only when better quantitative, macro-scale evaluations become available to support the effectiveness of the LL approach in terms of social and economic return on investment (ROI).

Conclusion

LL methodologies represent a new approach for innovation that has gained popularity over the last decade in different sectors: health, transport, urbanism, business, and industry. Its originality lies in the active participation of primary end-users and concerned stakeholders for the conception of products and services. Within this approach end-users play a central role contributing to the innovation process with their ideas, experiences, practices, desires, needs, and frustrations. The rationale behind this process is that it is the usage of the product that creates its value, and thus that this value is not completely predictable.

Experiments conducted within LUSAGE over the last years lead to the conclusion that user-driven innovation in the context of dementia care is not only possible but also highly desirable. This experience can be related to other initiatives and scenarios of smart cities development, which focus on age-friendly services or universal accessibility.

From our point of view, integrating and coordinating these efforts will prove critical in the near future. The ongoing structuration of specialized LL networks, such as the FFAH, should prove useful to this end. It will enable LLs to mutualize resources and standardize methodologies to ensure replicability and provide solid, opposable results, in order to guide the numerous public and private efforts being made to adapt our environment to the growing number of PwD who live at home and aspire, like any other citizen, to remain independent and included in society.

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Acknowledgement

The authors would like to thank our funding partners: Association France Alzheimer, Fondation Méderic Alzheimer, Fondation de France, Fondation Plan Alzheimer, Agence Nationale de la Recherche-Technologies pour la santé (ANR- TECSAN), Region Ile de France (IdF)- Fonds Unique Interministériel (FUI, PhD grants), Direction régionale des affaires sanitaires et sociales d'Ile-de-France (DRASSIF), Caisse Nationale de Solidarité et d'Autonomie (CNSA), Programme Hospitalier de la Recherche Clinique (PREQHOS), Réseau National des Technologies pour la Santé, (RNTS) European Commission, Seventh Framework Program (FP7), Ambient Assisted living Joint Program (AAL). We also want to thank all the persons with dementia and their families, health and social care professionals, local associations, and all the other persons that have contributed to our projects.

About the Authors

Maribel Pino (Ph.D. in Cognitive Psychology)
Scientific Director at LUSAGE Living Lab (Broca Hospital, Paris Descartes University), which is ENoLL member since 2012. Psychologist specialized in Human Factors/Ergonomics, her current research focuses on the use of assistive technology for dementia care, Living Lab methodologies, health policies, and frameworks for the design, provision, and assessment of assistive technology.

Samuel Benveniste (M.Eng., PhD in Human-Computer Interaction)
Deputy Head at CEN STIMCO, he assists the partners of CEN STIMCO in the user-centric conception and multi-dimensional evaluation of new technologies, programs and devices. His research work at MINES ParisTech focuses on assistive technology for cognition and on user empowerment and motivation in the context of dementia care. He is the creator of MINDs, a music therapy game for people living with moderate to severe dementia.

Robert Picard (Ph.D in Management Sciences)
Health Referee of the CGEIET, French Ministry of Economy. A Ph.D. in Management Sciences, he graduated from Ecole Polytechnique. His work deals with the identification and promotion of development factors of new uses of ICT, and their contribution to the development of the economy, with a focus on e-Health. He created and leads the Forum LLSA, a French network of LLs in the field of Health & Autonomy (Forum LLSA).

Pr. Anne-Sophie Rigaud (Ph.D. in Neuroscience, MD in Psychiatry and Geriatrics)
Professor in Geriatrics at the University Paris Descartes, she heads the Geriatrics Department in Broca Hospital and the Research Unit EA 4468, which focuses on Alzheimer's disease and includes the Living Lab LUSAGE. She also co-heads the Memory Centre of Resources and Research for Alzheimer's Disease and the French National Centre of Expertise for Cognitive Stimulation and Assistive Technology (CEN STIMCO).

Open Innovation in Health and Social Services

Minna Lappi, Oulu Business School, University of Oulu, Finland,
Riikka Hirvasniemi, Healthcare and Social Welfare, City Of Oulu, Finland,
Saara Pekkarinen, Oulu Business School, University of Oulu, Finland ,
Eeva Kiuru, Oulu Wellness Institute, Finland,
Maritta Perälä-Heape, Centre for Health and Technology, University of Oulu, Finland,
Sinikka Salo, Healthcare and Social Welfare, City of Oulu, Finland

Abstract

This paper examines the open innovation process in the context of health and social services. Through interviews with managers of a municipal organization, researchers and company representatives this study analyzes an open innovation process by defining elements and activities that are actually planned during the process as well as emergent elements and activities that just happen along as the process proceeds. In addition, the open innovation process is viewed from a co-creation perspective in order to determine activities for stakeholder engagement in the open innovation process. The theoretical approach is based on the research of open innovation process, value co-creation through learning and interactive communication, and roles as resources in value co-creation. The paper provides a description of the open innovation process and how planned and unplanned elements and activities affect the process and its results. In order to understand of stakeholder engagement in a complex collaboration network this study outlines what co-creation means in the open innovation process.

Keywords

User-centric; open innovation process; co-creation; public - private.

Introduction

This paper discusses the open innovation process planned and implemented in the Avaus project (Opening project). The project was founded in order to create the first version of the systematic regional innovation environment for health and social care in Finland.

In Finland, the duty to arrange equal public health and social services to citizens lies on local governments and is stipulated by several laws. The cost of health and social care has been a constantly growing component of municipal budget of the city in question in this study. On the other hand, the income from city tax was declining due to drastic changes in business structure, especially in the ICT sector, and an increasing unemployment rate of the city. Therefore, the need to balance the city economy was inevitable. The question was how to diminish the increase in the health and social care costs and promote competitiveness in the industry. The quality and coverage of service structure was still good. However, the need for change was acknowledged by citizens and decision-makers of the city alike, and this awareness for change intended to strive for improvement through an open innovation environment.

Until recently, developing new health and social services by public organizations relied extensively on the closed innovation model, with limited interaction with companies and other external actors (third, non-profit sector, user-communities etc.). The ongoing national and regional changes combined with the future changes related to citizens' needs for health and wellbeing services are driving forces behind open collaborative processes and service innovations. Therefore, the health and social care system has to enlarge into a collaborative network of multiple actors relevant to engage stakeholders in value co-creation. At present, there is a clear need to create a next generation, cost-effective, but still high-quality health care system that empowers citizens to manage and maintain their own health and wellbeing with the help of ICT, tools and personalized services, placing the individual in the centre.

The rest of the paper is organized as follows. The next section outlines the literature review on the open innovation process and co-creation activities and roles followed by a description of research methodology. The next section introduces the results of the study. Finally, the managerial implications for the open innovation process are examined in the context of health and social services.

Literature review

Open Service Innovation

Service innovation is defined slightly differently depending on the field of research, for example in economics, innovation is any change that influences one or more characteristics of the service (Gustafsson et al., 2012). In services, innovation process means "creative work undertaken on a systematic basis in order to increase the stock of knowledge… and the use of this stock of knowledge to devise new applications" and includes phases such as 'search' ideas, experiments and prototyping, and scaling up for the market launch (Bessant & Maher, 2009). Further challenges in the case of public services comprise a large number of stakeholders and the nature of the innovation, which means that there is pressure on cost efficiency and on fulfilling different customer needs. An open innovation process for developing new health and social services is needed to ensure for the users to participate in the development, and production of services based on their needs. In general customers' (co-creation) role in service innovation, although widely discussed is still unclear; what kind of role the user/customer really has in health and social service development.

The customer can be either an end consumer (e.g.in health care,) or a business customer (e.g. organizations purchasing health services or applications) who participates at some level in creating the service and ensuring their own satisfaction. Bitner et al. (1997, p 195) point out that "the customers have essential production roles that, if not fulfilled, will affect the nature of the service outcome. All forms of education, training and health maintenance fit this profile. Unless the customer does something (e.g. studies, exercises, eats the right foods), the service provider cannot effectively deliver the service outcome … If the organization does not do this, it and the employees involved will not receive the full benefits of the service".

Service Modularity. Rahikka, Ulkuniemi, and Pekkarinen (2011) see that the concept of service modularity offers an interesting avenue for service development and innovation. Modularity in services refers to "the smallest service unit that can be offered to a customer in itself or as a part of a service offering creating value perceived by the customer" (Rahikka et al. 2011, 358). Open innovations might utilize this approach to combine different actors' knowledge, services and processes to deploy modular, more effective health and social care solutions (Carlborg et al., 2013, p.14).

In modular care provision de Blok et al. (2013) see that developing care processes and health services e.g. for elderly living independently at home, as when customization is used to better meet each customer's needs, personalization can be used to adapt the way how the service is provided. The former requires learning about customer specific needs and developing the content of the service adequately, while the latter calls for the adaption in co-creation processes within the whole service system. The lesson is that the knowledge on the needs of each user or customer is not enough; the health care system and service providers need information to learn in which way the services are available not only for the users but also on a larger scale for others (see e.g. Elg et al., 2012).

Co-creation activities and roles

Interactive communication facilitates knowledge being renewed within a firm and between the firm and its external stakeholders. Ballantyne and Varey (2006, 346) emphasize that "co-production of value requires that marketers view service interactions relationally. Relationships are emergent by nature, a consequence of learning together over time. This applies to firms, customers, and all other exchange parties". Hence, managing collaboration has to encourage and support interaction and co-learning at all levels in innovation community and processes.

Co-Creation Value through Learning and Communication. Elg et al. (2012) go through the role of the customer (in their case, patients) in co-creation and learning related to developing more effective health-care processes and new services. The authors collected views and ideas from the patients in three healthcare processes through personal diaries on everyday life related to health-care problems, and contacts with service providers. The diaries were analyzed seeking first, all patient ideas for innovation and development of the care process, second, providing a summary report of texts and ideas of all patients to identify critical incidents in care processes (critical incidence approach), and third, thorough narrative analysis from selected patients to understand more deeply the patient's view on the service provided.

Communication is a mean of customer co-creation in service innovation depending on the type of innovation (incremental vs. radical) and a need to avoid the concrete products and solutions at a too early stage. Hence, the engagement of the users in innovation process requires the right tools and channels to engage the end users and paying customers in the process while keeping core stakeholders in control of the process. (Gustafsson, Kristensson and Witell, 2012.)

Roles as Resources in Value Co-creation and Co-production. Vargo and Lusch (2006) argue that value co-creation involves all the activities associated in the creation of value, including the development of potential and exchangeable resources by a service provider, as well as the derivation and determination of value by those who benefit from the service, which means that co-production involves a subset of value-co-creation processes associated with the development of the core offering of the firm.

This distinction by Vargo and Lusch (2006) suggests that a customer's social roles as value co-creator differ (although they are not mutually exclusive) from a customer's social roles as co-producer. As a co-producer a customer will contribute to the development, design, and/or assembly of a firm's offering (e.g. customization or self-service). Both co-production and value co-creation generally refer to the integration and application of resources, but while value co-creation contributes to the creation and determination of phenomenological value, co-production refers to contributing to the development of potential and exchangeable resources anywhere in a value network. For example, if the customers in health-care value networks customize services through interaction with the service provider they can be seen as co-producers. Value co-creation and co-production can occur concurrently. (Akaka and Chandler, 2011, p. 255.), for instance, when a person enjoys the experience of designing and assembling but all co-production may not derive value for the customer as she/he may not enjoy e.g. fulfilling a questionnaire, or a diary for self-control of health.

Our theoretical approach to analyze the open innovation process with the objective to find either planned and unplanned/emergent issues, or realized and unrealized issues, and how these can help or hinder reaching the objectives of innovation processes, is based on von Koskull and Strandvik (2013) findings that in service innovation literature the dominant approach is either a very structured and sequential process or a non-structured, circular process. In an innovation process that calls for open collaboration with many actors involved, as in service innovations, a more dynamic strategy would be appropriate.

Research questions

This study focuses on the open innovation process as a platform for regional health and social service innovations. Founded in early 2012, the Avaus project aimed at building a systematic regional innovation environment for health and social care. Firstly, the Avaus project aimed at making possible open collaboration between public and private actors already early on in the service development process. Secondly, the aim was to build a collaboration model enabling a better match between citizens' needs and health and social services. In addition, the aim was also to place the customer's point of view as a central motivation for service innovations. Based on these objectives within this case study setting we ask:

> *What elements are appropriate for an open innovation process?*
>
> *Which co-creation activities can be identified for a stakeholder engagement?*

Methodology

Qualitative research methods were adopted in the current study, since the aim was to increase our understanding by studying a previously under-investigated phenomenon that is complex in nature (Yin, 2003). A case study is an appropriate research strategy to study processes related to collaborative networks, even though challenges occur considering the methodology in collaborative networks research due to the complex nature of such networks (Halinen and Törnroos, 2005).

Open innovation environment

The national and regional structural changes combined with the future demographic changes, increase in chronic conditions related to lifestyles, expensive new technologies and products as well as the need of more specialized skills in a diminishing work force in health and social care were drivers to explore a new innovative process allowing a kind of service model in public health and social services. To explore, plan and test innovative processes for creating an open co-developmental collaboration model aimed at engaging not only internal resources within the organization but also external stakeholders in a network in innovating new health and social services.

Data gathering and analysis

The main sources of data were six semi-structured interviews conducted with three employees of the public service provider and three representatives from companies and research organizations involved in the Avaus project during the time relevant to this study. One of the interviews concerned two persons, so the total number of interviewees was seven. The interviewees were core persons in the Avaus project and representatives in the companies and research organizations involved in two chosen cases within the Avaus project. The interviews were carried out between mid-December 2013 and early January 2014. Four of the interviews were conducted in the premises of the city, while the other two took place in the interviewees' offices. The duration of the interviews varied from 45 minutes to 68,5 minutes, with an average length of 56 minutes. In addition, other data of the current study included documentation produced in the Avaus project.

All the interviews were recorded and fully transcribed before analysis. Data analysis was initiated by studying the transcribed interviews, after which they were categorized into themes. Data analysis and the search for complementary theories occurred in parallel interactive processes as the researchers moved between theoretical concepts and gathered data seeking to understand theories and the data in question (Dubois and Gadde, 2002).

Results

This section presents the findings of creating an open innovation environment for health and social services: 1) open innovation process, 2) stakeholder engagement and 3) service innovations.

Open innovation process

Due to the present changes in citizens' needs and broad ongoing changes in the health and social sector, the environment is very complex and therefore multiple skills are needed for the management of service innovation process: skills in innovation, business life, change management, orchestration of a collaborative network and expertise in health and social care etc. The management of such a complex innovation process concerning multiple public and private actors should be carefully balanced in each case.

Creation of the open innovation process. The first steps to build an innovation process within the Avaus project were open seminars where the challenges of future health and social services were discussed. Participants in these seminars were company and research organization representatives and individuals who were interested in the development of health and social services. One of the main purposes of these seminars was to motivate participants to come up with new and radical ideas and solutions for future service innovations.

Based on these open seminars the project team started to build procedures for the activities within the innovation process and ended up with four main phases in the process. The process is illustrated below (Figure 1. The planned innovation process). Next some examples of activities in the innovation process are explored to emphasize a complex nature of public and private collaboration.

Figure 1. The planned innovation process

1. Need and problem identification

In order to find the needs of citizens, they were motivated to share their feedback about the challenges in the current service process. This motivation took place in citizens' forums that were an essential tool to enable citizens to participate in the co-creation process in order to find new solutions that could better fit their needs and wishes. The citizens' forums consisted of service users as participants. Especially some heavy users of health and social services, senior citizens and persons with only little technological skills had a possibility to give their input for the development of future services. The purpose of these forums was to provide direct feedback of the quality of services. The aim was to collect ideas and make proposals for improving services. In addition to these citizens' forums, other chosen channels for gathering feedback were public UBI displays located in public places in the city and a virtual environment for volunteer citizens to provide feedback while willing to test new products and services.

Healthcare professionals also had a key role in the first phase of innovation process. They were supposed to identify the most problematic and challenging service areas. The idea was to choose the most expensive services and services with a growing demand.

There were four areas chosen in the Avaus project, two of which are examined in the current study. The first one considers support for elderly living at home and the second one support for those suffering from obesity.

2. Developer community motivation

The problems chosen in the first phase were considered as innovation challenge cases. In the second phase of the innovation process challenge cases were shared openly for motivation of the developer community to find new ideas to improve the current services. Innovation challenge cases were shared in open seminars, social media (Facebook) and other media. A special formula was created to make sure ideas were presented in an appropriate and easily comparable style, which also made the processing of the ideas easier.

Innovation challenge case 1:
Problem and need: To support seniors living independently at home
Background: 92% of those over 75-years of age who are still livening at home use health and social services. Typically these services include help in every day routines like personal hygiene, getting dressed, toilet visits, and overall mobility at home and in the local neighborhood, eating, and satisfying other basic human needs. Seniors living at home often feel lonely and unsafe, they seem to lack meaningful activities, have some troubles building social contacts and face challenges in using technological aid independently.

Innovation challenge case 2:
Problem and need: To strengthen citizens' own responsibility of their lifestyle changes to struggle against overweight and obesity
Background: Overweight is the fastest growing health problem in all Western countries. There is a huge need for new cost-efficient, result-oriented weight management innovations. The use of mobile technology, adult pedagogy and behavioral psychology to support citizens to take responsibility of their own life-style changes could provide new solutions to the problem. Obesity is directly connected to other diseases such as high cholesterol and blood pressure, diabetes, cardiovascular diseases and musculoskeletal disorders. The prevention of life-style based diseases depends on the choices individuals wish to make in their everyday lives to fight obesity.

3. Collection and evaluation of ideas

The team responsible for the collection and evaluation of ideas is called the innovation team. It consists of health and social service experts in the public service provider organization, a non-profit coordinator in business, a coordinator in health and technology and business experts in the public developer organization. Multiple skills were integrated in the team to allow development and integration of resources in an effective way.

The most potential ideas were chosen and presented in a Fast-Track session directly to the innovation team. Managers of the public service provider in the service area were invited to join the session together with the innovation team to listen to the idea owners presenting their ideas. The experts gave their feedback and chose the most interesting ones for further discussion.

The ideas that were not quite ready yet, were forwarded to Idea-Meetings. By meeting other innovators and idea owners the ideas became stronger, as individual idea developers had a chance to meet others and to co-operate. Companies could make joint development initiatives and form new partnerships. Service experts also had a chance to give direct feedback to idea owners.

The collected ideas were classified based on their maturity to pilot, research and development projects.

In the Avaus project the ideas for innovation challenge cases could take many forms. They could be a new product or service, a web service, a mobile service practice etc. It was important that the idea really provided a solution to the problem that was related to the challenge. It was required that the idea presenter could show a proof of both cost efficiency and service quality improvements. Any individual person, group, organization or company could participate in the innovation challenge.

A total of 23 ideas were received for innovation challenge case 1 (support for seniors living at home) and seven for case 2 (support for obesity problem).

Ideas for the two innovation challenge cases were evaluated according to value-based criteria:

Service design and customer orientation
- Is the idea customer centric? Are there service design elements involved? Is there a plan to involve customers in the development process?

Self-care promotion
- Does the idea utilize self-care thinking? Does the idea increase the freedom to choose?

Digital channels / services
- Does the idea utilize a multichannel approach?

Multiple provider model
- Is the idea built on multiple provider model? Does the idea complement the relevant public

services? Is the idea market-oriented? Does the idea enable co-operation possibilities with other parties?

Flow of money and information

Does the idea enable flexible and smooth flow of money and information between different parties such as citizens, relatives, volunteers and third sector, primary care and specialized medical care?

Benefit

What is the economic benefit to the customer and other stakeholders?

Need

Does the idea provide a viable solution to the given problem? What is the potential of the solution?

Competition

What other solutions are available and why is your idea better than they are?

4. Further development

The ideas classified as ready for piloting projects, were directed to Health Technology Test Centre for testing in a real healthcare environment. In these cases the focus was on the integration between the idea and other relevant products or services.

Potential but still immature ideas were provided support and guidance for processing them together with the idea owner and innovation process partners. In fact, the idea owners were encouraged to co-operate with relevant partners in order to get funding for the idea development. These partners may include the coordinator in health and technology, and the technology development funding organisation, or the pilot funding organisation.

Planned and unplanned elements/activities of the innovation process. The first research question examines how planned and unplanned elements and activities affect the process and its results. The findings are summarized in the table below (Table 1. Preplanned innovation process – planned and unplanned activities).

Table 1. Preplanned innovation process – planned and unplanned activities

	Planned elements/activities	*Unplanned elements/activities*
Planning the open innovation process *Criteria of evaluation*	Model for project management & operational preconditions: - objectives - finance - ownership - partners, stakeholders	Within a public organization: - a more open discussion of internal decision making - more fluent cross sectorial internal collaboration
Identification of need & problem	Development of - new methods and processes - devices and digital tools to support new practices – health technology - case history / customer data record system	Contradictory goals: – national/regional; public/private; research/business; health/social/hospital district
Activation of developer community *Idea Generation*	Coordination of - relevant problem identification - initiatives for solving existing problems - motivation within different actor groups (companies, research organizations and citizens) - development activities in a collaborative network	A challenge of unclear role of public funding organizations; Misunderstanding about the specific business funding within the project
Collection & evaluation of ideas	Implementation of - value based criteria for innovative ideas - procedures for creating new solutions for service innovations	A challenge of unclear roles of public and private actors: - resource allocation - concrete actions in co-development
Further development of chosen ideas	Validation of - solutions - potential for solving the original problem - business opportunities	The partners' role in providing support in processing the most potential ideas

The open innovation process was planned, described and implemented in the Avaus project. Activities and procedures matured during the process. There were some unplanned, sometimes suddenly appearing challenges, proposals or other emergent issues that happened along the way towards the open innovation process. These unplanned elements or activities affected the planned activities and they could be negative or positive in nature. For example, in the very beginning of the project requirements for service innovations were articulated in a relatively general way, because the team wanted to collect as many ideas as possible. The requirements for new ideas were defined as no need to hire new personnel in the future, improvement of productivity or emphasizing the central role of service users when creating more user-friendly solutions. Thus, at first the team wanted to keep the goals very open, but quite soon different kinds of contradictory interests started to occur both nationally and regionally. The pressure caused by these contradictory interests led the project team to give up their original goals and adapt them to different opinions.

The Avaus project gained attention on national, regional and international levels. There was a remarkable pressure nationally from external public partner organizations and locally from companies and research organizations towards the project and city organization. Expectations were huge as according to a common opinion (without any actual proof of it at that point) the Avaus project had the best possibilities to solve all kinds of problems and challenges that ever existed in the health and social service industry. These extremely unrealistic expectations affected the project itself, but they also influenced the atmosphere in the public service provider organization. It seemed that the external pressure enabled more open discussion on organizational decision-making and more fluent cross-sectorial collaboration internally.

In addition to the occurred external pressure, the interests within the project and among the partners concerning the open innovation process were relatively different. This was probably due to the fact that locally the open innovation process was implemented for the first time and there were only little experience related to collaboration between public and private sectors. Partners (a researcher and a company representative) emphasized in their interview that the public service provider was a crucial partner for them, since companies through an access to potential service users could co-develop their services with the public service provider to match their solution to service users' needs. Occasionally the public service provider considered these partnerships as an attempt on the part of companies not to co-develop but instead to sell the solutions to the public actor, and if successful, to have the first and the most important reference.

The interviews revealed that the role of national public funding organizations remained somewhat unclear to the researchers and company representatives who participated in the process. This was probably the factor that influenced on the innovation process and its results the most.

Stakeholder engagement

Co-creation activities for stakeholder engagement in an open innovation process include interaction, learning and resource integration. The second research question explores a stakeholder engagement in a complex collaboration network and the concept of co-creation in an open innovation process.

The key stakeholders for open public - private collaboration include multiple actors. The service innovation and co-creation literature suggests that citizens, the potential service users, are the most important actors in value co-creation. The new value-based health service concepts aim to empower individuals for self-management and support their own health and wellbeing processes. The role of citizens is crucial as they are in the center, and responsible for their own health and wellbeing. Customers' role in value creation follows the idea of value-in-use, which means that value is created when customers use services (Vargo and Lucsh, 2006, Rahikka et al., 2011).

In addition to customers, other stakeholders identified as key stakeholders in the process were experts in the health and social sector, healthcare professionals, managers of the public healthcare services and entrepreneurs, experts in business, research and innovation experts and funding organizations.

The data showed that during the innovation process stakeholders were supported to engage in the process in several ways. Service innovation literature suggests that interaction, learning and resource perspectives are needed in an open innovation process. Collaborative involvement including elements of relationship building, active multi directional communication and knowledge exchange is essential within a network in order to be successful in an open innovation process (Cova and Salle, 2008). In the case of the Avaus project several co-development workshops were organized by the project. Citizens were engaged in citizens' forums by providing them with virtual tools such as UBI displays and the PATIO-service. Special innovation workshops consisting of persons from research organisations, hospital district and the third sector were also arranged.

Development of potential and exchangeable resources and integration of resources are included in co-creation activities for stakeholder engagement (Akaka and Chandler, 2011). From an interaction and resource integration aspect co-development includes building partnerships with those who benefit from the relationship. Our data showed that the innovation process was a starting point for a future partnership between ICT companies and a research organization. The co-development was very dynamic and focused on business opportunities.

Communication has a central role in stakeholder engagement in the innovation process. The data revealed that active communication with all the relevant actors is important when appropriate procedures and roles are identified within the collaborative network. A manager in the project team indicated in the interview that in the beginning the team put a lot effort in communicating what the innovation process is, how it is structured and what outputs are expected. With the aid of communication the project team assumed that actors in the network get activated, know the procedures and are able to act accordingly. However, the project team did not get as good feedback as they wished for. A researcher who was active in the innovation process commented on the co-development and communication comparing it to an earlier experience she had had with the public service provider:

> *'There was a process this time and we knew what would happen and what the schedule was. This time was better. ... We knew the phases in the process, but we didn't know, when we would have the feedback from our idea. ... And then we were asked to go and give a presentation on our idea, but we didn't know who the people in the room were and why the presentation was necessary.'*

Research on co-creation within service innovation suggests that engagement of service users in the innovative process requires appropriate tools and channels (Gustafsson, Kristensson and Witell, 2012). The innovation process enabled ideas to be shared and evaluated, feedback to be received and guidance to be provided for getting on the process. Open events were citizen forums, Avaus seminars and workshops. Virtual tools were mainly for citizens to give feedback to developers.

Service innovations

Innovation challenge case 1: Support for seniors living independently at home
A private research organization suggested the idea of using technology to activate seniors physically at home, providing them a social aspect at the time. The idea seemed to have very good potential and it was conducted to the Fast-Track process. The idea was facilitated in the innovation process by the public coordinator in health and technology and introduced in an open seminar. After the presentation ICT companies became interested in the idea. The research organization took control of the co-development with a few of the most potential ICT companies. Several months later the partners were negotiating on funding with the public technology funding organization.

Innovation challenge case 2: Strengthen citizens' own responsibility for their lifestyle changes to struggle against overweight and obesity
In an open seminar three idea owners were asked to give a presentation on their ideas and solutions. First, a public research organization had a mobile application solution for supporting lifestyle changes in the case of overweight or obesity. Second, an ICT company introduced a software for diabetes control. Third, a private healthcare provider presented an idea of a web portal for weight control. All the three solutions were chosen for further development in the innovation process. Avaus was the starting point for their future collaboration and partnership. The co-development was very dynamic and it was intensively facilitated by the coordinator in health and technology. The public research organization was the dominating partner. During the co-development new partners were introduced. During the further development phase two of the ICT companies wanted to leave the partnership since they could not see any business potential or other benefits for them. The co-development continued and gradually the original three proposals became one with a strong intention for raising funding as a collaborative network.

Conclusions

The purpose of this study was to identify how planned and unplanned elements and activities affect an innovation process and how stakeholder engagement is achieved through co-creation in a complex network in the context of health and social services. This was accomplished by drawing on empirical data that investigated actors in the Avaus project. As a result of this study an open innovation process with planned and unplanned elements and activities within the process were defined. Also activities for stakeholder engagement and service innovations as a result in an open innovation process in health and social services were introduced.

The Avaus project gained strong attention with severe contradictory interests on national and regional level, mainly because Avaus was a real attempt to create the first version of a systematic regional innovation environment for health and social care in Finland. There are special requirements for making an open innovation process possible in public health and social services in Finland. Nationally, the roles and interfaces in co-development between public and private actors in health and social services need to be clarified, and a model for funding public and private co-development needs to be discussed on national level. Locally, an open collaboration within public health and social services needs to be an ongoing process with intense interactive communication between actors in such a network in order to allow the development and integration of potential resources. This kind of resource integration requires new skills and attitude to consider other actors in the network as equal partners as well as integrating the new open innovation process to be a part of the public service provider's organization.

An open innovation process is a complex collaboration network especially in the case of public health and social services with a large number of stakeholders and a challenge of cost-efficiency services for fulfilling different needs. Managing and orchestrating such a network therefore requires multiple skills particularly in an environment with significant changes. The Avaus project was launched at the same time as a vast reform of legislation concerning both national and regional structure of health and social care was ongoing in Finland. Simultaneously, in the region in question a large municipal merger was prepared, and finally completed in January 2013.

Further research is needed to understand how service users can be involved intensively in the innovation of health and social services and how resources can be integrated in order to innovate effective health and social services.

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Acknowledgement

Ministerial Adviser Hannu Hämäläinen, Ministry of Social Affairs and Health, Finnish Government, is acknowledged for his continuous support to establish and develop open innovation process.

About the Authors

Minna Lappi (M.Sc., D.D.S.) is a Doctoral Student at the Oulu Business School of the University of Oulu. Her research interests include value co-creation and customer experience within the context of wellbeing services. The plan for her doctoral thesis is 'Value co-creation in health value network: Digital services supporting individuals in daily life settings'. She also works as a Managing Director of Minero and as a Consultant in customer projects in the healthcare sector.

Riikka Hirvasniemi (M. Sc.) is a Development Coordinator in the City of Oulu. Her work is related to health and social eServices. Since 2007 she has worked in many wellness development projects associated with eServices, health promotion and treatment of chronic diseases. Most recently, she was a project manager in the Opening – project. She also has earlier experience in working as a nurse with patients suffering mental problems or dementia.

Saara Pekkarinen (D.Sc.) is a Senior Research Fellow at Oulu Business School, University of Oulu. Her research focused previously on microeconomic behaviour (consumer, supplier), cost-benefit and value analysis and consumer/user satisfaction. At the moment, she is actively involved in the SHARP Research group (www.oulu.fi/sharp/) with focus on value, co-creation, experience, modularity and business ecosystem perspectives in professional and health & wellbeing services.

Eeva Kiuru (M.Sc.) is Executive Director at non-profit Oulu Wellness Institute. She is active in creation of health innovation community focusing on customer-centric co-operation between public sector, academia and entrepreneurs. Recently, as head of Wellbeing Knowledge Cluster Oulu, she coached over 400 healthtech start-ups. She is healthtech columnist and Wellness Business Blog writer. She has worked for Polar Electro and holds two heart rate monitor patents.

Maritta Perälä-Heape (PhD) is Director of the Centre of Health and Technology. She promotes the strategic collaboration of founders from academia, industry and healthcare providers in the innovations of personalized health care. Prior to working at CHT she worked for the Finnish funding agency for innovation and technology as a life science expert, research program manager and director of the innovation and international business unit. She has also worked as an R&D and business development manager in a biotechnology company. Her earlier academic research interests focused on the life sciences and biotechnology.

Dr. Sinikka Salo (Ph.D., D.D.S.) is Deputy Mayor in the City of Oulu, Finland. She is responsible for healthcare and social welfare. Since 1991, she has held a number of leading positions in municipal and governmental organizations. She has also worked as researcher at Oulu University. Dr Salo is a sought-after lecturer both in Finland and abroad, and she has published more than 60 scientific or popular articles. In 2005-2007, Deputy Mayor Salo worked in Sendai, Japan, as the director of the Research and Development Unit of Sendai-Finland Wellbeing Centre.

The Competitive Advantage of an Ecosystemic Business Model: The Case of OuluHealth

Noora Jansson, Oulu Business School, University of Oulu, Finland,
Petri Ahokangas, Oulu Business School, University of Oulu, Finland,
Marika Iivari, Oulu Business School, University of Oulu, Finland,
Maritta Perälä-Heape, Centre for Health and Technology, University of Oulu, Finland,
Sinikka Salo, Healthcare and Social Welfare, City of Oulu, Finland

Abstract

Although scholars show increasing interest in business models and ecosystem thinking, few studies have focused on their combined exploration. In this study, we draw on business models and ecosystem analysis to better understand how business models relate to opportunities and advantages in the context of a health care ecosystem that involves both private and public organizations. In our community-based research, we examined a recently established health care ecosystem in northern Finland, OuluHealth. As the result of our analysis, we propose that the competitive advantage of an ecosystemic business model is strongly related to how the unique interplay of different stakeholder groups is realized within the ecosystem. Our argument is that while each organization has its own vision and strategic goals, opportunities and advantages can be better exploited when the different value propositions compose an entity, an ecosystem value proposition. We also offer interesting suggestions for further research at the intersection of business models, ecosystems, and health.

Keywords

competitive advantage, business model, ecosystem, health care, innovation

Introduction

Business models are important to ecosystem thinking, as they have a key role in distinguishing open innovation from earlier research on inter-organizational collaboration in innovation (West & Bogers, in press). The business model's purpose is to create and capture value, and it is the tool for innovation commercialization (Teece, 2010; Chesbrough, 2010). Chesbrough (2012) stated that open innovation processes combine internal and external ideas jointly into platforms, systems, and architectures. Such processes utilize business models for defining the requirements for these architectures and systems. We can even claim that a mediocre technology pursued within a superior business model may have more value than a great technology in a mediocre business model (Chesbrough, 2010). In the design of networked or ecosystemic business models, the focus shifts from creating value through internal activities to creating value through external relations. These value networks or ecosystems, as we call them, have been recognized as an important part of open innovation cooperation in, for instance, information and communications technology (ICT) or agricultural biotechnology (West & Wood, 2008).

The centrality of relationships is characteristic of open innovation (Rajala, Westerlund, & Möller, 2012). Firms that practice open innovation strategies rely on the cooperation of external firms to provide components, complements, and customers for the innovations of the focal firm (Chesbrough, Vanhaverbeke & West, 2006). Open innovation researchers have theorized that value networks or business ecosystems can play an important part in such open innovation strategies (West & Wood, 2008). An ecosystem typically contains a high degree of interdependency among member firms, and the member firms normally benefit from the value-creating members of the ecosystem. However, prior research has emphasized the importance of certain firms playing a leading or guiding role such a business ecosystem (Iansiti & Levien, 2004).

The efficiency and effectiveness of cooperation among network member firms has often improved through the use of information technologies (West & Wood, 2008). For instance, the development of digital technologies has created new opportunities for designing open exchange relationships with partners, customers, and even competitors. Thus, competitive advantage has started to shift from the venture and its internal stakeholders, such as management, employees, and shareholders, to the surrounding business ecosystem, which also includes external stakeholders such as partners, vendors, and customers. These kinds of communities and value networks have long been identified as an important source of innovations and value creation (Chesbrough et al., 2006; West & Lakhani, 2008; Zott & Amit, 2007).

However, limited empirical work has been done on the process of creating such ecosystems and the forces and processes that cause them to evolve over time (West & Wood, 2008). Therefore, we examine a health-focused ecosystem and its possible business models as a case study to investigate how business models and ecosystems coevolve. We also consider how business models might respond to and shape the selected case ecosystem through exploration and exploitation (March, 1991). The research question this study seeks to answer is "How do business models relate to opportunities and advantages in the context of an ecosystem?"

This paper starts by introducing the theoretical framework surrounding the discussion on business models and business ecosystems through definitions and the construction of a converged frame for an ecosystemic business model. We then present the research methodology and our research context, the OuluHealth ecosystem. We describe our analysis in the discussion section by bringing together the theory of business models and ecosystems and the case ecosystem. Finally, we offer conclusions and proposals for further research.

Theoretical framework

We construct the theoretical framework by first defining business models, then defining ecosystems, and finally introducing the concept of an ecosystemic business model.

Business models

In recent years, the concept or framework of business models has gained popularity among practitioners and researchers as a tool for describing and analyzing new ways of doing business (Zott, Amit, & Massa, 2011; Onetti, Zucchella, Jones, & McDougall-Covin, 2012). However, no single definition of the business model has achieved the position of a dominant conceptualization either in research or in practice, although the conceptualization of Osterwalder and Pigneur (2010) is often referred to. They defined the business model as consisting of nine elements: value proposition, customer segments, channels, customer relationships, key activities, key resources, key partners, cost structure, and revenue streams. But the business model has also been described as comprising the elements of strategic choices, value network, value creation, and value capture (Shafer, Smith, & Linder, 2005); value proposition, the value creation and delivery system, and value capture (Richardson, 2008); or focus (what?), modus (how?), and locus (where?) (Onetti et al., 2012).

From a practical viewpoint, the business model has been seen as showing promise because of its simplicity, compactness, and easy visualization—and the same qualities of the business model can be utilized in research settings, too. For example, McGrath (2010, p. 249) observed that "the business model concept offers some intriguing opportunities to capture better how a given set of resources translates into something a customer sees as valuable and is willing to pay for". Among the numerous definitions of the business model concept (for comprehensive literature reviews see, e.g., Zott et al., 2011 and Onetti et al., 2012), it has been referred to as an architecture (e.g., Timmers, 1998; Teece, 2010), a recipe (e.g., Baden-Fuller & Morgan, 2010; Sabatier, Mangematin, & Rousselle, 2010), a narrative (Magretta, 2002; George & Bock, 2011), a cognitive map (Chesbrough, 2010), a design (Smith, Binns, & Tushman, 2010), or an actualization of decisions and actions (Tikkanen, Lamberg, Parvinen, & Kallunki, 2005) for *competitive advantage*. To reach a competitive advantage, the business model has to meet customer needs and be non-imitable, as successful business models tend to be imitated rather quickly (Teece, 2010).

Adding a new element, Hacklin and Wallnöfer (2012) discussed the business model as a cognitive framework to successfully exploit a *business opportunity*. Despite the existence of various business model definitions, a common feature of the definitions is that the business model represents the logic of *value creation and capture* (Shafer et al., 2005; Teece, 2010), and that it embodies the structure, architecture, or framework of the business (Teece, 2010; George & Bock, 2011), thus rooting the business model in the business context. Teece (2010), for example, argued that business models are calibrated in context. Since business opportunities are made to create and deliver value for stakeholders, as Ardichvili, Cardozo, and Ray (2003) argued, business opportunity can be seen as the key to the business model. Thus, if a firm is to establish a competitive advantage based upon an opportunity, its business model has to be differentiated, effective, and efficient. Furthermore, the elements of the business model must work as a system (Teece, 2010) that extends beyond organizational boundaries and also involves the exchange partners of the focal firm (Zott & Amit, 2010; Nielsen & Bukh, 2011).

In this paper we see business models as built around the business opportunity, either for companies or for other stakeholders in the ecosystem. In emerging, dynamic, and complex environments business models help to answer the questions of what companies are offering to their customers in terms of products/services and value proposition, how and where they are planning to do that in practice, and why they think they can do it profitably. Key elements of this business model concept, built around the business opportunity, include the following:

1. What? (offering, value proposition, customer segments, differentiation)
2. How? (key operations, basis of advantage, mode of delivery, selling, marketing)
3. Why? (basis of pricing, way of charging, cost elements, cost drivers)
4. Where? (location of activities/items, internally or externally in the network or ecosystem; applicable to all preceding items)

Our intention is this paper is to elaborate on the traditional business model perspective from company-based thinking to cover also academia and the public sector, which are central stakeholders in the case study that we analyze below.

Ecosystems

The preceding discussion on the business model presented it as a boundary-spanning concept (Zott et al., 2011). The challenge of business model conceptualizations has been how to connect the business model to its context. Teece (2010) pointed out that business models cannot properly be calibrated without assessment of the respective business environment; that is, business models are part of a business context. To understand the complexity of business entities' interconnectedness with each other and with the broader business environment, some researchers have started to examine it from ecological perspectives. Moore (1993, 1998) stated that there are parallels between business and natural ecosystems, as both are partly intentionally formed and partly a result of accidental emergence. Like biological ecosystems, business ecosystems are characterized by high complexity, interdependence, cooperation, competition, and coevolution (Iansiti & Levien, 2004). Ecosystem members evolve symbiotically, that is, they coevolve, through simultaneous collaboration and competition (Iansiti, 2005).

Iansiti and Levien (2004) shared Moore's (1993) view on the ecology analogy; they envisioned a complex, multi-contributor business ecosystem infrastructure that can be fragmented and modular. Because of the constantly evolving relationships among ecosystem members, the boundaries between them are fluid. Furthermore, a business ecosystem can cross a variety of industries and encompass a variety of organizations, making the identification of its exact boundaries both theoretically and practically difficult.

Business ecosystems are self-organized, and because of their structure decision-making within them is decentralized. No single organization can control the entire system, but there can be several major players governing the ecosystem (Iansiti & Levien, 2004). Each member must maintain bargaining power over other members (Moore, 1993) and focus on managing the complexity and interdependencies within its particular domain (Moore, 1998). Short-term exchanges are governed by contracts, but community governance is also practiced by leader companies, which Moore (1998) called "ecosystemic form organizations" (E-form organizations). There can be shifts in leadership and roles within an ecosystem, and one player can have different roles in different domains. Also, a business ecosystem consists not only of collaborating businesses but also of any other organizations, institutions, and individuals that have an impact on and interest in it.

The evolution of an ecosystem consists of stages: birth, expansion, leadership, and self-renewal or death (Moore, 1993). Pagie (1999) and Peltoniemi (2006) have discussed three different types of ecosystem coevolution: competitive coevolution, mutualistic coevolution, and exploitative coevolution. Competitive coevolution means that different companies compete for the same pool of resources. The evolution in such a situation tends towards more efficient utilization or acquisition of these resources. Mutualistic coevolution is based on the parallel change of actors towards better compatibility, as both benefit from tighter integration. This is usual for complementary offerings, as in the evolution of software and hardware. Exploitative coevolution, on the other hand, does not benefit all the participants in the interaction; rather, a more powerful organization pushes the evolution in a certain direction (Pagie, 1991; Peltoniemi, 2006).

Following the notion of coevolution, success at the ecosystem level is determined by robustness, which means the ability of the ecosystem to transform as the environment changes. Even if individual firms within the ecosystem fail, a robust ecosystem is able to recover and persist. Such adaptability and flexibility is required of the ecosystem especially in a complex and turbulent environment (Hearn & Pace, 2006).

The ecosystemic business model

Newer conceptualizations of business models take the external environment and ecosystem into account and emphasize collaboration in value creation. The ecosystem view of business models embraces the principles of open innovation by focusing on innovation and novelty, with a constantly evolving, loosely coupled structure. Rather than merely competing against other networks or firms, an ecosystem member competes and collaborates with others within the ecosystem as well as with external actors. An ecosystem cannot strive for a status quo, as constant innovation cannot be reached without constant evolution over time (Lehto, Hermes, Ahokangas, & Myllykoski, 2013).

Therefore, the ecosystemic view on the business model is of great importance, as it is based on the principle that if a venture remains isolated from outside entrepreneurs and ventures, it will not be exposed to the best ideas and opportunities and will not be able to exploit them (Amit & Zott, 2012). Our intention in this study is to extend this view from companies to include the public sector, such as municipalities, because we believe that research units and public players can also benefit from and add value to an ecosystem.

The best way to generate new ideas that may lead to innovation entails expanding the firm's boundaries, as companies can use open business models to create and capture value by systematically collaborating with outside partners (Osterwalder & Pigneur, 2010). In a similar manner, a public organization is capable of expanding its boundaries. The underlying rationale behind the concept of open innovation is that "no company is smart enough to know what to do with every new opportunity it finds, and no company has enough resources to pursue all the opportunities it might execute" (Wolpert, 2002, p. 80). Consequently, the focus of open or ecosystemic business models is a *collectively* created value proposition among participants from both the private and the public sector.

Open, ecosystemic business models enable an organization to be more effective in creating as well as capturing value, as they help create value by leveraging many more ideas because of their inclusion of a variety of external concepts. They also allow greater value capture by utilizing a firm's key asset, resource, or position not only in the organization's own operations but also in ecosystem member businesses (Chesbrough, 2007). Therefore, in an open environment the synergy and compatibility of the business models of those belonging to the ecosystem have a central role (Myllykoski & Ahokangas, 2013).

A business ecosystem can be seen as a bundle of interlinked business models. The interconnected processes of *value cocreation, cocapture,* and *co-opetition,* as well as *coevolution* of the ecosystem and different actors within it, determine these connections. Value is cocreated among various actors within a network as a joint effort as well as together with the customers. In addition to value cocreation, an equally important aspect is the ability to capture value, which in the networked context can be called value cocapture. The term "co-opetition" refers to the coexistence of competition and cooperation within the value-creating business network or ecosystem. Co-opetition demonstrates the increased complexity of the current business environment, where companies simultaneously compete and cooperate with each other. This is based on the notion of duality, while value cocreation can be seen as a cooperative process and value cocapture as a competitive one (Myllykoski & Ahokangas, 2013).

The coevolution of the ecosystem's business model with firm-level business models further explains why (technology-based) firms join, stay in, or leave the ecosystem at certain points in time. Van der Borgh, Clood, and Romme (2012) discovered that in order to enhance and reinforce the ecosystem's business model, ecosystem managers must *deliberately* facilitate exit routes for companies that no longer fit the ecosystem. Thus, the importance of the ability to transform and adapt is emphasized even further so that the ecosystem is able to persist.

Research design

The primary research method of this study was a qualitative case study, which is a suitable approach to increase understanding of complex social constructions, such as ecosystems (Miles & Huberman, 1994). The case study is presented in the form of a grand narrative, because narratives are useful in explaining context-dependent human activity (Gubrium & Holstein, 2008).

The data about the case study were retrieved through the active involvement of three representative key persons in the case ecosystem, who are coauthors of this paper together with two other researchers. The in-depth participation of the ecosystem representatives in the research and analysis is a strength as well as a weakness of this study. The strength is that the researchers truly understand the context of the case and its historical trajectory, whereas the weakness is the possible bias in objectivity. However, the involvement of organizational representatives in the research process is not only accepted but even recommended by community-based researchers (Wallerstein & Duran, 2003). Community-based research is especially suited to studying public health–related phenomena, because it allows a case-specific analysis of physical, social, and structural components involving the members of the particular community, organizational representatives, and scholars (Israel, Schulz, Parker, & Becker, 1998).

The case: The OuluHealth ecosystem

As explained earlier, the research question of this study is "How do business models relate to opportunities and advantages in the context of an ecosystem?" In order to develop an analysis setting for the question, a case was selected. Case studies are useful in exploring answers to "how" questions: they allow context involvement and they are flexible (Yin, 2003). A case is also a unit of analysis (Baxter & Jack, 2008). In this study, the case is an ecosystem called OuluHealth.

The selected case, the OuluHealth ecosystem, comprises several stakeholders from academia, the public sector, and the private sector. The research context offers an interesting reflection point for studying business models and their potential in a real ecosystem, because the ecosystem is an actively developing network of several hundred organizations.

The OuluHealth initiative has its roots in the 1970s or 1980s, depending on the chosen perspective, but it was officially launched in 2011. The principal idea was to facilitate open collaboration and to accelerate innovation by bringing together various partners able to contribute to the needs of the health care sector. As the starting point, three priority areas for development were defined: Individualized Connected Health, Future Wellness Services, and The Future Hospital. Thus, OuluHealth can be characterized as an innovation platform that facilitates the collaboration of professionals, service providers, research communities, companies, business communities, and citizens in the fields of health care, well-being, the life sciences, and ICT. A systematic collaboration model and easily accessible physical development, simulation, and testing facilities compose a unique living lab for the partners locally, nationally, and globally.

In physical terms, OuluHealth is located in Kontinkangas, a health campus close to the center of the city of Oulu. The OuluHealth campus has developed around the Oulu University Hospital, opened in the 1970s, and is quite unique in the way that it compactly combines both public and private actors in the health care sector, ranging from Biocenter Oulu to a wide spectrum of small and medium-sized (SME) businesses. Led by a steering team composed of the central players in the ecosystem, the participants are dedicated to developing the OuluHealth campus and collaboration models towards an internationally known "future Silicon Valley of health care".

The ecosystem of stakeholders (e.g., health care services, an online self-care platform, and an innovation partnership) is a useful starting point for the coproduction of seamless health care services and for implementing the digital agenda in health care. The ecosystem approach enables the combination of expertise from wireless information technologies and life science to introduce smart ICT solutions for delivering advanced, personalized, connected health service solutions. Some examples of the tools and processes supporting this convergence include a Medical Simulation Lab and a 3D Virtual Lab Cave for designing physical premises and work processes, where professionals and companies from any field can innovate together. In sum, the OuluHealth ecosystem strives to be a forerunner in creating innovative solutions to global challenges in the health care sector, aiming for the efficient return of investments and, most importantly, for the creation of jobs and health.

The grand narrative of OuluHealth

To develop a comprehensive explanation of the case ecosystem, we chose to utilize a narrative method. A narrative, that is, a story, is a useful way to capture socially constructed realities as an accumulation of narratives (Gubrium & Holstein, 2008). The background, key development paths, and strategies that have guided the development of OuluHealth are presented in the form of a grand narrative.

Setting the scene: Finland, the city of Oulu, and health care transformation

Since 2010, a vast reform of legislation concerning both the national and the regional structure of health and social care has been ongoing in Finland. As a result, Finland will organize its future social and health services through 5 large districts constructed around the university hospitals. Legislation of this new centralized model will be finalized during 2014. In northern Finland, five municipalities in the Oulu region have recently merged. The new city of Oulu, with its 190,000 inhabitants, is the fifth biggest city in Finland.

The national and regional structural changes combined with the future perspective of demographic change, an increase in chronic conditions related to lifestyles, expensive new technologies and products, and the need for more specialized skills within a diminishing work force in health and social care were the drivers to explore a new, innovative process to redesign a smart service model in Oulu. There was a clear need to create a next-generation, cost-effective but still high-quality health care system that empowers citizens to manage and maintain their own health and well-being with the help of ICT, tools, and personalized services.

The economic dilemma motivating innovation

In Finland, the duty to provide equal public health and social services to all citizens lies on local governments and is stipulated by several laws. Like in other Finnish cities, in Oulu the cost of health and social care has been a constantly growing component of the municipal budget. On the other hand, the income from city taxes has been declining because of drastic changes in business structure, especially in the ICT sector, and an increasing unemployment rate. Difficulties in balancing the city economy were inevitable. The question was how to minimize the rising cost of health and social care and promote competitiveness in industry.

Oulu—an experienced transformer

The city of Oulu is a good example of how creating the right environment for an innovation ecosystem is a key to success and competitiveness. Oulu's transformation from a stagnant industrial region in the early 1980s to a vibrant high technology center from the 1990s onwards has been based on a highly successful public-private partnership (PPP). For decades, the Oulu PPP has produced an exceptional hi-tech track record, particularly in the ICT sector.

However, in most Finnish municipalities including Oulu, public service provision has been arranged mostly through hiring public-sector personnel; the purchase of services from the private sector has played a minor role. In Oulu, a policy of increasing PPP in the provision of city services was adopted based on an agreement of confederacy (approved by the Finnish State Government, 7th October 2010). Moreover, the philosophy of enabling the participation of citizens and companies, together with the authorities, in designing city services and their implementation was incorporated into Oulu city strategy.

Strategic choices to boost innovation

Oulu Innovation Alliance (OIA) acts as the primary tool in translating research results into innovative policies and outcomes. OIA was formed in 2009 among the city of Oulu, the University of Oulu, Oulu University of Applied Sciences, the Technical Research Centre of Finland (VTT), and Technopolis (a business real estate company) to continue Oulu's long tradition in R&D cooperation between education and research, companies and the public sector, and to minimize the gap between research, policies, and real-life implementation.

Oulu has a master innovation strategy, which is systematically updated to address changes in the economic climate and in which all business branches are potential innovation domains. The local health care sector ecosystem, the OuluHealth ecosystem, was born out of this strategy, as the result of an interactive process across the innovation ecosystem. Oulu University Hospital has been one of the leading parties pursuing the OuluHealth ecosystem collaboration. From OuluHealth's point of view, another key stakeholder in the process of translating research into policies and finally into practical outcomes is CHT, the Centre for Health and Technology.

OuluHealth executing regional and national goals

With the novel ecosystem of OuluHealth, the city of Oulu expects to gain growth and several hundred new jobs locally. Nationally, the new, innovative concepts created by the OuluHealth ecosystem can be adopted by other service providers to gain better health and well-being in more cost-effective ways. The OuluHealth ecosystem is also at the heart of national innovation. As part of the Finnish Innovation Policy Programme for 2014–2020, the city of Oulu was chosen to lead the national Future Health program. Oulu is responsible for driving the national activities together with other big cities in Finland, with the goal of providing a joint action plan for the health care sector.

Towards ecosystemic business models: Value proposition and long-term vision

Since value creation and capture are central to business models (Shafer et al., 2005; Teece, 2010), we close this section by presenting the OuluHealth value proposition (OHVP; figure 1) and the ecosystem's long-term vision (figure 2). Figure 1 illustrates the convergence of the respective visions (black boxes) and value propositions (blue boxes) of the public health and social sector, academia, and private sector. Together, these form a combined value proposition that is relevant not only to each member but also to interested parties beyond Oulu and Finland. A key feature of the value proposition is the explicit role of ecosystem facilitation.

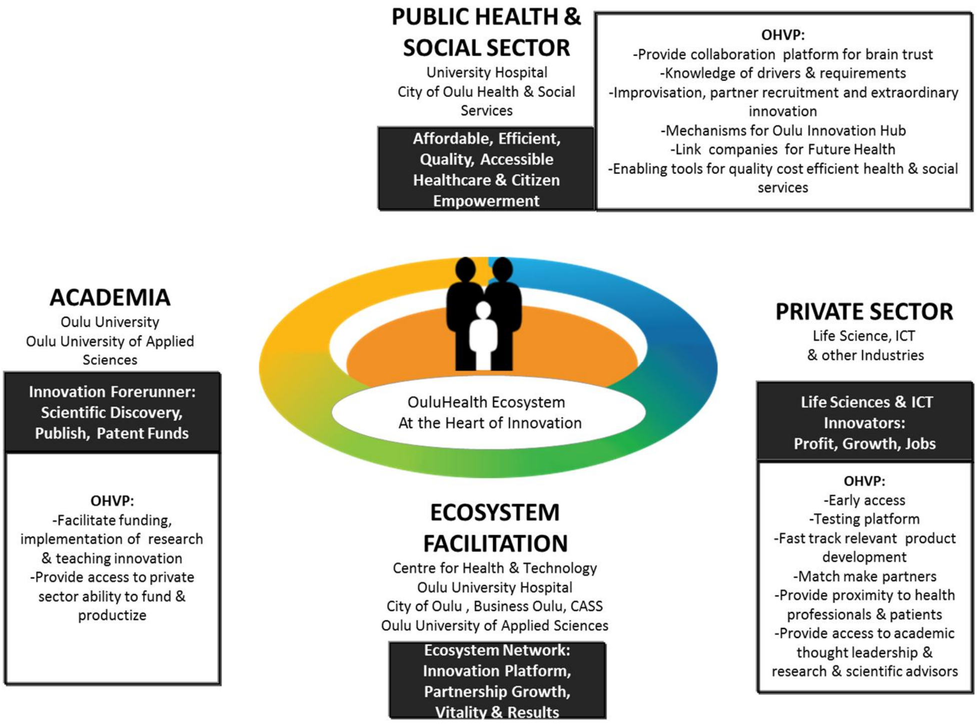

Figure 1. Ecosystem Value Proposition for Key Stakeholder Groups in the Case of OuluHealth

As ecosystems tend to evolve in stages (Moore, 1993; Pagie, 1999; Peltoniemi, 2006), OuluHealth's long-term vision is captured in evolutionary steps. Furthermore, since a crucial characteristic of an ecosystem is that it is partly self-organized and cannot be directed by a single organization (Iansiti & Levien, 2004), the long-term vision has to remain flexible and sensitive to changes.

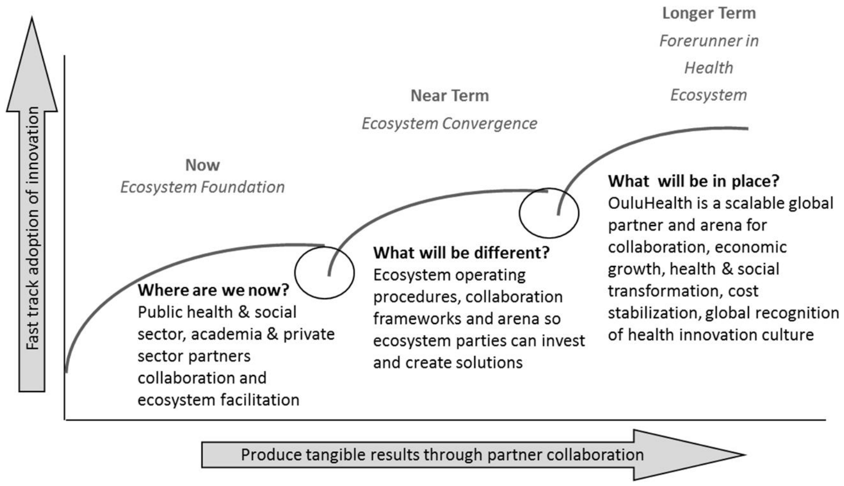

Figure 2. Ecosystem Long-Term Vision in the Case of OuluHealth

We have now provided definitions of business models and ecosystems, proposed a theoretical framework, and described in some detail the case ecosystem in the form of a grand narrative. Next, we share our analysis of the ecosystemic business model in view of the case study presented.

Discussion and conclusions

As we have explained, the OuluHealth ecosystem is at a very early stage in its evolutionary path. Nonetheless, this case study allows us to offer an explanation of how business models relate to opportunities and advantages in the context of an ecosystem. We are aware that such an explanation draws on hypothetical scenarios instead of the more traditional retrospective case study results. Our community-based research methodology is supportive of our choice of approach (Wallerstein & Duran, 2003).

We propose that business models relate to opportunities and advantages in the context of an ecosystem through a dynamic interplay in which different stakeholder groups genuinely fulfill their expected roles in the value proposition of the ecosystem. The unique combination of various roles adopted not only by companies but also by academic organizations and the public sector will create a unique and strong value proposition This type of ecosystemic business model is very difficult to imitate, and it thus creates a competitive advantage characteristic to ecosystems (Teece, 2010).

In the case of the OuluHealth ecosystem, this stakeholder interplay means that in order for the ecosystem to evolve, each key stakeholder must implement the particular strategic initiatives that will initially support the achievement of its own vision but that, just as importantly, are crucial for the ecosystem to develop competitive advantage and to evolve. Figure 3 illustrates how the key stakeholder groups in OuluHealth (public healthcare partners, academic partners, private sector partners, and the ecosystem facilitation team) all have a role to play in the bigger picture of the ecosystem.

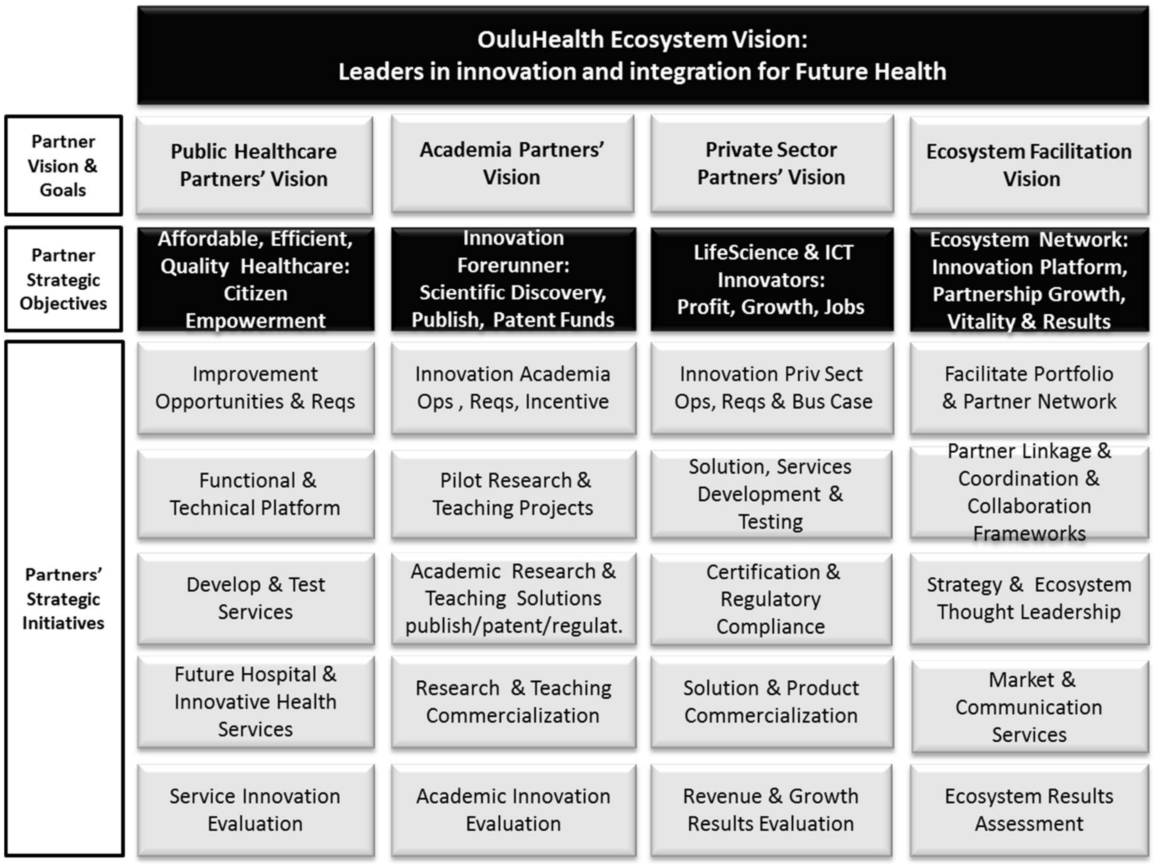

Figure 3. The Unique Interplay among Ecosystem Stakeholders in Striving for Competitive Advantage in the Case of OuluHealth

The analysis suggests that while the business model concept may create remarkable competitive advantage (Ahokangas & Myllykoski, 2013), in the context of an ecosystem the competitive advantages are either cocreated by several stakeholders or controlled by dominating partners. The findings also indicate that as ecosystems are formed by several different stakeholders who might have conflicting targets, ecosystemic business models are challenged by the targets' interplay and coexistence within the ecosystem. However, the diversity of business models may also be the strength of an ecosystem, as the failure of one business model does not necessarily spell the failure of the entire ecosystem. In fact, an ecosystem may become stronger after unsuccessful businesses are removed.

For scholars, our study offers an alternative view on ecosystems, a view that considers not only companies as key stakeholders of an ecosystem, but also any other kinds of organization relevant to those companies, such as universities, municipalities, and hospitals. This research demonstrates originality by combining the theory and practice of ecosystems and the business models suited to them. In addition, there is little research on business models and ecosystems in the health care sector. The value of this study lies also in business model evaluation, as the health care sector is in the midst of transformation, exploring and exploiting new business models.

An interesting avenue for further research could be to analyze different business models in different ecosystems in order to increase understanding of the universalities and the particularities of the phenomenon. Another interesting direction would be analyzing health care sector transformation and opportunities through the ecosystem lens, and vice versa.

For future citizens and patients, there is a clear need to create a next-generation, cost-effective but still high-quality health care system that empowers citizens to manage and maintain their own health and well-being with the help of personalized services. In the Individualized Connected Health model, the citizens are placed at the center of health service development; they participate actively in their health care processes and coproduce the services and health data. In this model, the end user can actively intervene in choosing the best time, place, means, and tools to support his or her personal capabilities for self-care and well-being. To extend active and independent living through open and personalized solutions, citizen-friendly innovations are needed. The multidisciplinary nature of the challenge allows us to redirect our research efforts towards truly innovative openings that address the changes and needs of modern society. OuluHealth has the ability to identify scenarios and technological requirements from a long-term perspective and to bring more value for citizens, society, and business.

We hope that opening the case of OuluHealth provides a useful showcase of an ecosystem and its characteristics. Oulu has demonstrated a strong emphasis in building future public health care services for its citizens and in developing a dynamic innovation ecosystem for the health and wellness sector. Oulu is currently undergoing an interesting transformation period, and the OuluHealth ecosystem is supporting the success of that transformation. How the various businesses will grow and how the upcoming Oulu University Hospital renewal project will be realized remains to be seen. Through this evolutionary development process, the OuluHealth ecosystem brings together companies, the hospital district, universities, research institutes, the city of Oulu, and, above all, the citizens. Through their active interplay, the key stakeholders of this unique Nordic health care ecosystem are collectively creating future health services in open systems and open collaboration regionally, nationally, and internationally.

To conclude, our analysis indicates that business models relate to opportunities and advantages in the context of an ecosystem through an intelligent and committed interplay among the key stakeholder groups. Each stakeholder must understand its role in the bigger puzzle of the ecosystem, so that it can both exploit and deploy the ecosystemic business model.

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About the Authors

Noora Jansson (MSc) is a director at BusinessOulu, and she is responsible for operational facilitation of the OuluHealth ecosystem. Previously she has worked in the telecommunications sector and as the development director of the Hospital District of Helsinki and Uusimaa. She is also a doctoral candidate at the University of Oulu Business School, studying organizational change. [noora.jansson@gmail.com]

Petri Ahokangas (PhD) is an adjunct professor and a senior research fellow at the University of Oulu Business School. Previously he has worked as a professor of international business and in various director-level positions in the software industry. He is also an active entrepreneur and serves on several boards of directors in the software industry.

Marika Iivari is (MSc) is a Doctoral Candidate at the University of Oulu Business School, studying open innovation in an entrepreneurial SME context. She is also currectly involved in a European Regional Development Fund project focusing on Living Labs in the context of integrative urban planning. She holds a Master's degree in International Business with distinction from the University of Ulster, Northern Ireland.

Maritta Perälä-Heape (PhD) is a director of the Centre of Health and Technology. She promotes the strategic collaboration of founders from academia, industry and healthcare providers in the innovations ofpersonalized health care. Prior to working at CHT she worked for the Finnish funding agency for innovation and technology as a life science expert, research program manager and director of the innovation and international business unit. She has also worked as an R&D and business development manager in a biotechnology company. Her earlier academic research interests focused on the life sciences and biotechnology.

Sinikka Salo (PhD, DDS) is the deputy mayor of the city of Oulu, Finland, responsible for health care and social welfare. Since 1991, she has held a number of leading positions in municipal and governmental organizations and worked as a researcher at the University of Oulu. Salo lectures widely and has published more than 60 scientific and popular articles. In 2005–2007, she worked in Sendai, Japan, as the director of the R&D unit of the Sendai-Finland Wellbeing Center.

Organising Living Lab Pilots for Maximal Impact

Petra Turkama, Aalto University School of Economics, Center for Knowledge and Innovations Research, Finland

Abstract

This paper presents a representative real life case on integration of open innovation and Information and Communication Technologies (ICT) in service design and delivery in a Smart City context. The presented virtual home care concept and end-to-end service were created in a Living Lab set up in collaboration with users, health care specialists, technology providers and city officials. Drawing from the lessons learned during the two-year project, the paper presents practice based recommendations for future public service design and innovation projects. The project was considered a huge success, and provided several new views to the use of ICT in home care, and provided grounds for drawing generally applicable conclusions for collaboratively delivered public services. The identified key success factors were: 1) integration to existing service offering and ICT systems, 2) structural changes in the service providers' organization and roles, 3) change toward service oriented mindset, as well as 4) high level support and commitment from top management.

Keywords

Public Service Design and Delivery, Living Lab

Introduction

Advanced Information and Communication technologies are considered as the key enablers for the radical renewal that have been called for in public service design and delivery. The new technologies enable both the creation of novel products and services, as well as new models for engaging citizens and other stakeholders in service creation. With the increased pressure for public sector transparency and citizen participation, the cities increasingly engage in real life experimentation together with private sector, citizens and academia. While this is a welcomed development that has lead to development of a few exceptional concepts and solutions, most such pilots have not lead to commercial take up. This has left the participants frustrated and discouraged, and making it difficult for new pilots to be launched.

This paper addresses this identified challenge, and explores the enablers, barriers and critical success factors in Smart City service design projects. It further provides practice based recommendations for organizing future experimentation and Living Lab pilots for concrete results and maximal impact. The recommendations are based on a two-year virtual home care project in Helsinki, and generalized to apply for broader range of services by filtering out context related factors and comparing the results to earlier research in the field. The paper contributes to the existing knowledge base on technology enabled service design and adaptation in Living Labs.

The paper is structured as follows: 1) the contextual setting: political, financial and societal pressures to improve effectiveness and quality of the health care services that support independent living, 2) the case set up, actors and key decisions with their implications on the project outcome, 3) the enablers, surprising predicators and barriers for commercial implementation of the service, 4) the key learning and recommendations for the future cases.

Political, Financial and Societal Context

With the aging population and limited budgets the cities in Finland, like in the rest of the world, are under increased pressure to innovate new means to meet the citizens' increasingly diverse health care needs. In Finland in 2010, the cost of home care services increased by 24 million euro (3.3%) compared with the previous year, totaling 756 million euro. Similarly, there has been growth of people needing home care on a regular basis; the amount of clients has increased 5.1% between the years 2010 and 2011 exceeding 71600 people. Improvements are sought through increasing the effectiveness of service delivery through process re-engineering, organizational changes and outsourcing. Cities increasingly re-structure and combine their health care and social service organizations in order to fulfill their legal obligations with reduced workforce. This has lead to longer waiting times for patients and increased workload for the health care workers. Simultaneously, outsourcing and increased use of partners have resulted in complex service portfolios and delivery networks that can lead to compromised customer experience and quality of service without proper coordination. However, cost reduction is not a sustainable solution for the challenge at hand. There is a need for radical product and service innovations that change the way the customers' needs are met. Hence the governments and cities invest in research, development and innovation of ICT enabled services.

The current regulations highlight the focus on preventative care and patient self-empowerment for independent living. The elderly today are also more educated and have access to latest information in the field and anticipate better care and service experience. With this, the patients' diverse needs are approached holistically, and solutions are designed in co-creation with the patients. This calls for systemic approach to service design, whereby the various actors in the service delivery network must collaborate in delivering the final service. This requires application of advanced ICT systems for knowledge management and information sharing, and increasingly also as a component of the delivered service as well. Especially in health care, patient privacy and data security are high priorities. Therefore real life testing of the solutions and system integration is needed in order to ensure patient safety at the introduction of new services.

The national strategy for health care in Finland emphasizes preventative care and patient rights to make decisions regarding their own care. The cities are obliged by law to cater for the needs of the diverse demographical groups, categorized by their health and social status, and provide basic care accessible for all groups free of charge, or by affordable price. Citizens' preference to live home as long as physically possible has lead to the emergence of a completely new market for home delivered services. In Helsinki these services are organized partly by the city health care and social services departments, and partly by city owner private company Palmia. In anticipation of privatization of state and city owned companies and new home care related regulations, Helsinki faces sense of urgency to re-organize their home care services and introduce new service concepts.

In paper Finland poses all the makings for successful open innovation and technology experimentation. In addition to the sense or urgency to innovate and long tradition of user driven development, Finland promotes Open Society development at the highest political level. National innovation policy advocates demand and user driven policy instruments, and the national funding agency for technical and industry research has specific instruments for open and user-driven innovation. Finland also systematically invests in technology, and especially mobile technology, related research, innovation and development.

With this instrumentation the Finnish innovation environment provides good opportunities for experimentation with new types of innovation and partnership models.

Case: Helsinki Virtual Home Care

Helsinki is a pro-active developer and experimenter of technology innovations and citizen engagement in various fields including traffic, energy, open data, and health care. Helsinki demographic is somewhat exceptional with a high number of families with small children and retirees. With this, Helsinki spends a lion share of its' budget to health care and social services. New solutions are continuously experimented with in small scale pilots. However, with home care, the city felt the need to take a higher risk and launch a larger scale long term project on renewing home care services.

The case project started with Helsinki participation in the European Union FP7 PSP CIP project APOLLON (Advanced Pilots of Living Labs Operating in Networks). In the APOLLON pilot the focus was on proof of concept for virtual home care, and supporting small and medium size companies (SME) in internationalization. The virtual home care technology was provided by a Belgian SME, and had been previously used in social interaction between home and health care provider, but not in actual care operations. It was soon discovered that the technology could not be used in Helsinki due to broader scope of service. In Helsinki the solution had to be financially sustainable, and that could only be achieved by performing patient care through the system. In practice the video calls had to replace physical visits to the patients' homes. At that point the pilot evolved into a more focused virtual home care service design project for the benefit of the city of Helsinki.

The project participants in the Helsinki pilot were the Center for Knowledge and Innovation Research at Aalto University, a home care unit in the City of Helsinki, Palmia and Forum Virium Helsinki. The latter two of the companies involved in the project (Palmia and Forum Virium Helsinki) are owned by the City of Helsinki. The virtual videoconference equipment was provided by private companies, Arctic Connect and Tunstall. The objective of the pilot was to improve patient care through increased interaction and reduce the number of physical visits via video connection. The new channel for connecting with the care personnel was expected to reduce loneliness and increase confidence to act through improved sense of security and immediate access to care. Further to social interaction, the system was also used for performing simple care operations like reminders of meal times and medicines, checking of insulin levels and general condition of the patients. For patients with dementia the regular calls established routines to the day and enabled independent living.

The system consisted of a touch screen computer, a panic alarm phone, a microphone, a loudspeaker and two cameras; one attached to the screen pointing towards the user sitting in front of the computer, and the other with possibility to angle and zoom in the premises of the home care patient. The equipment was connected in clients' homes to internet and placed in living room or bedroom. The calls could be initiated either by the home care employee or the home care patient. The patient was also able to make an alarm by the panic alarm phone attached to her wrist, in which case the nurse could open the video connection without approval from the patient. The technology had been previously used between health care centers in specialized health care in remote areas in Finland, but not in the home context. Thus the pilot provided the technology provider important feedback on the system features and possible adjustment requirements in home use.

The system was installed in 20 patients' homes, and used as a part of their every-day care. Each patient had different care needs, and was defined specific goals that the video system would serve. These goals included reduced number of care personnel visits following remote reminders, increased sense of security due to a new point of access to the care personnel, reduction of alcohol abuse due to accountability and regular contact, as well as prevention of declining health conditions. The care personnel also tried to identify patient types and services that were best replaced or supported by the virtual connection. Each patient was interviewed 2-3 times during the pilot in order to collect their feedback and experiences with the system over time. Also the nurses using the system were interviewed and asked for ideas and suggestions for the application of the system. In the end, all inputs were collected together to draw conclusions on the applicability and added value of the solution. Also a business model for the services was modeled with predictions for the revenues and associated costs.

In addition to the product testing, the project provided a platform for experimenting with collaboration in service delivery between the various organisations. Previously a part of the care (alarms) was handled by Palmia, while the Helsinki Home Care unit delivered the daily care. The organisations had different patient data systems that were not integrated, as well as very different processes, organizational culture and approach to patient care. During the pilot, the new processes and systems for organizing the care were defined, and responsibilities and revenues divided accordingly. An important, yet almost sub-continuous, change was the definition of the care services, service levels and costs for all care operations. Thus the logic of delivering and reporting work followed private sector logic ´care as a service´. This was a major point of departure for Helsinki Home Care, where the operations had not previously considered as single services.

Due to patient security and privacy reasons the solution had to be first tested in controlled laboratory setting, which delayed the schedule. After that the technical set up was found surprisingly easy, even time consuming due to local restrictions. After the initial set up the technology providers provided good user support throughout the pilot. The patients' acceptance of the technologies and comfort level of using the system were among the main surprises. The technologies have matured to the level that they are easy to use intuitively even by patients that have never used computers or mobile phones. Touch screen technology also proved to be easier than mobile phones with small screen and buttons for the elderly to use.

The main challenges were caused by the differences and collaboration between the two care organisations. The challenges were partly accounted for a missing shared patient database, and partly to change resistance following the new allocation of responsibilities and different orientations at public and private sectors. Identifying these institutional factors as the rooth cause for the challenges was among the main findings in the project. The challenges were overcome by understanding the various parties' position and clearly defining and sharing the common goals. This included e.g. agreeing on the scope of the services provided, especially on the side of social interaction. For the Home Care personnel the social interaction with the patients was considered as an important part of preventative care, whereas Palmia wished the service to solely consist of listed and pre-defined care services.

The project provided a good opportunity to apply Living Lab philosophy in real life setting. The leading partners, Aalto University and Forum Virium Helsinki were experienced in conducting Living Lab experimentation, and thus the proposed set up was easily accepted by Home Care management. Due to earlier projects, the processes for experimenting with the city were clear and well documented. Furthermore, local regulations defined clearly the legal documentation required to protect the participating patients' security and privacy. The project plan along with required confidentiality documentations were presented to the Board of Helsinki Health Care division, which then gave the project the permission to proceed. The clear reporting structure and framework gave the project management a clear path to follow and thus reduced risk and sped up the progress. The rigid reporting structure also ensured that the highest management was aware of and supported the project, and could step in if issues arose.

The project resulted in commercially available virtual home care service, provided by Palmia. All project stakeholders benefited from the project as expected. The table below details the results by stakeholders.

Table 1. Various Stakeholders Objectives and Results in the Pilot Project

Stakeholder	Objectives	Results
Technology providers Arctic Connect and Tunstall	Gain experience in application of technology in the context of homes	Important feedback on the technical solution, especially on the level and frequency of the sound, the screen saver, product manual text and the location of cameras.
Helsinki Home Care	Experience in using technology in Home Care delivery	Good experiences in complementing current care with the virtual home care technology, especially in reminders of food and medicine, simple operations and general check up of the patients' condition.
Patients	Experience in using technology	Technology was accepted surprisingly well and the use of technology was far easier than the users first expected. The sense of security and confidence to live independently increased. No issues with privacy concerns or fear of loosing human contact.
Palmia	Experience in working with Helsinki Home Care, designing new service	Important experience in collaboration with Home Care and expanding the scope of offered services. Development of shared patient data system for increased efficiency.
Forum Virium Helsinki	New service design, proof of concept in using Living Lab approach	Living Lab approach was used successfully, and lead to new pilots in other areas. Serving the city by leading the project designing a new service for the city.
Aalto University	Representative user driven innovation case to increase understanding of the phenomena and contribute to the knowledge base	Analysis of the pilot impact and results for further understanding of the applicability of Living Lab experimentation for public service design. Important results from the various stakeholder interviews on their experiences in the pilot. Recommendations for the set up of future pilots.

Lessons Learned

The project was considered a success from all stakeholders point of view. In the final evaluations the assessment focused on the actual artifact, the developed ICT enabled service, and the various stakeholders perceived and experienced value-add in using it. However, in addition to this public outcome, the project also yielded important results and learning for the project team. The lessons learned were carefully analysed for the benefit of the future projects and for the research purposes to increase understanding of IC T enabled service design and the use or open innovation and Living Lab development methodologies. This chapter focuses on these methodology and process related results.

The key lesson learned was that the main barriers for the innovation were related to organizational and human factors rather than anticipated technical or economic factors. The differences in public and private sectors institutional logics and mental models were under-estimated, which lead to misunderstandings within the project team. This finding was reflected to earlier research in the field in order to assess its' general applicability in collaborative service design cases. The research in the field in deed states that the various partners conflicting agendas and objectives is among the key challenges in collaboration. Thus the results supported the earlier results from the private sector, and extended it to the public-private partnership context. The project further demonstrated that such challenges were best overcome by 'learning by dong' approach, where the partners worked together to better understand how and why the other organization worked as they did in practical level instead of reading reports of process descriptions. Living Lab experimentation provided a good platform for such bottom up rapport building and learning in relevant, real life context with reduced risk before the actual commercial product launch .

Table 2. Lessons Learned

	The Key Enablers	**The Key Barriers**	**The Main Surprises**
Technology	Advanced, reliable, easy to use technically mature and tested solution	The lack of integration of the various organisations' patient data systems	The patient acceptance and willingness to use the technology
Organisation	Participation and positive attitude of the care personnel	Limitations in the time that the service could be offered	The speed the care personnel accustomed to using the solution as an integral part of the care
Methodology	Experience in and positive attitude towards Living Lab experimentation	Limited number of users	Patients' willingness to join the project, the fast decisions made based on the project results
Management	Top management commitment and support. Clear, repeatable structures and processes for piloting	Various organisations' competing and partly conflicting agendas	The speed of decision making related to the launch of commercial product and service after the two-ear pilot
Service	Patient and care personnel participation in service design and testing	Scope of service limited due to security concerns	No issues with privacy or use of service

The key enablers for the success were the support from the city management, the partners' high level commitment to the project, and dedicated project organization. With legacy of numerous pilots the attitudes of the nurses were first skeptical, but due to the sense of urgency and strategic importance of the project the anticipated results could be realized. The patients' attitudes and active participation were the other critical success factors in the project. As the technology proved easy to use, the initial reservations wore off and the patients actively used the system and provided important feedback and observations in the interviews.

From the methodology point of view the key to success was the earlier experience in using similar development methods. With this the decision to launch the project was achieved fast, and the project could proceed seamlessly following pre-defined guidelines and processes. The main barrier was the limited scope of the project. The team would have appreciated a broader user base, but with the time and budget limitations the 20 users was the maximum available. The project proved that the concept works well in design and development of health care services and collaboratively provisioned service models.

Recommendations for Future Pilots

This chapter summarizes the lessons learned in the pilot for the benefit of future pilots applying user driven and open innovation concepts. The recommendations are given on general level for Smart City services, free of references to the thematic field of e-health or context of Helsinki. The recommendations build on the basic assumption that advanced use of ICT technologies is the way to best address the needs to renew current public services and introduce new service concepts. Neither do the recommendations question the benefits of involving users in service design and real life experimentation. Focus is on identifying means to best organize the Living Lab pilots for maximal impact and added value for all stakeholders.

The recommendations are given in the categories that were identified as the main areas of improvement and impact in the pilot, namely technology, organization, management, and user engagement (use of Living Lab methodology).

Technology
Mature technologies and solutions work best in Living Lab set up. Working with real life cases, the technology must be reliable enough to serve the purpose and provide grounds for the analysis. typically the solutions must be first tested in controlled test environments, and the user engagement is handled through other means of interaction. Once the solutions are tested, Living Lad can be used for further validating them in use, and providing input to finetuning and finalizing the solutions. Living Lab also works well for testing technologies in new contexts of for slightly different purposes than first planned.

Living Labs work well for ICT technologies, since as temporary, usually project based set up, it is important that the technical installations can be done fast and with low cost. Living Labs provide a risk free platform to collect feedback and investigate the user acceptance and take up of the solutions. it also serves well integration testing with legacy systems and new system componens. For more investment and asset heavy technologies Living Labs can serve as one step in the more longitudinal testing and validation processes.

Organization
Working in Living Lab set up takes practice, and thus is best organized with experienced partners. Familiarity with the related concepts, methodologies and processes speeds up the process, provides comparable results and builds trust among the project team. Ev if there is less experience, there are numerous resources available online for pilot planning and execution. The project team can assess the relevant solutions and needs for online tools etc. support. The commitment of the team is another key success factor. The organisations must be committed from top management to the actual users of the tested solutions. Only then can the pilots be fully implemented and results achieved.

The participants must represent top organisations in their field and be committed to support the solutions also after the pilot. The developed products and services must meet the needs of the users and be robust enough to stand commercial competition. In publicly funded projects there is a tendency to compromise the outcome for the benefit of broad participation or SME inclusion. However, this can lead to situations where the solutions are not competitive and the partners have wasted efforts on solutions that can not be implemented in use. Also the financial sustainability must be planned, including business model, earning logic for different partners and the competitive edge.

Management
Top management must be involved at least from the project owners' organization. The pilots typically lead to structural changes in organisations, including new job roles and responsibilities. These can only be conceptualized and implemented with management support. Top management participation also ensured fast decision making during the pilot. Decisions regarding the follow up actions will be done in the last phases of the pilot, and management can drive adjustments or budget re-allocations if needed for the next steps. Management can also make the decision to call off the pilot. Exit strategies is an area typically overlooked in Living Lab pilots.

Living Labs represent co-development and networked innovations. However, the projects require clear owner with a vision of the pilot outcomes and impacts. The owner needs to have the means to engage the other organisations, and provide an attractive enough offering for the others to join the development. The project owner can typically be a public sector organization or a technology platform provider. Dealing with real customers, the sustainability of the service must be planned from the beginning of the project before the customers grow dependent on the service and it becomes a routine. In the future projects, more attention should be given for the conceptualizing the service's business model, even when designing public services. With the corporalization of public sector, the laws of private sector increasingly apply to public service delivery as well.

User engagement
Living Lab philosophy builds on user engagement and empowerment throughout the development cycle. The concept has proven its' applicability and benefits during the past decade, and user engagement still remains in the heart of the concept. The user engagement serves multiple purposes, including early prediction of user take up of the solutions, user inputs to service development, as well as more intangible purposes like customer relationship building and users'

control and participation of services related to their own consumption and use. Thus carefully planned user engagement is critical to successful Living Lab pilots.

User engagement methodology must be planned case by case depending on expectations and the context. Research has shown that the results vary depending on whether the user participation is sponsored or voluntary. Also the access to representative sample of users is a major consideration: the project must engage the current and potential future users of the solution, as well as the non-users, as a broad sample, rather than testing with university students or focus groups. This is where Living Lab as a real life set up shows its' strength.

Discussion

This paper presented practice based recommendations for organizing Living Lab pilots in Smart City context. The results build on a single case study, but were reflected on earlier research in the field for broader applicability. The presented case study suggested that the main opportunities in Living Lab piloting exceed the product or service related improvements, but rather serves as a risk free platform for experimenting inter-organisational collaboration for service design and delivery in real life setting. The organizational concerns also presented as the main challenge during the piloting. The results were very promising and proved that Living Lab concept lends itself well to end-to-end design of public services. Further cases in different thematic areas would be needed to further prove the applicability of the observations and the recommendations.

About the Authors

Petra Turkama, Dr.Sc. (Tech.)

Dr. Turkama is the Director of an academic research center, Center for Knowledge and Innovation Research (CKIR) a Aalto University School of Business. She is an academic management Professional with vast international experience in directing and promoting academic institutions, research projects and educational programs in Far East Asia and Europe. She has broad based multi-disciplinary research experience in ICT innovation, service science and policy studies, as well as 10+ years industry experience in technology marketing and business development in telecommunications industry. Dr. Turkama is an active contributor to international innovation and technology management conferences, committees and boards, as well as science and innovation policy.

Well-being Services in Collaboration for Senior Citizens

Hanna Tuohimaa & Liisa Ranta, Laurea University of Applied Sciences, Finland

Abstract

The aging population in Finland brings about a challenge for the public sector in being able to offer enough good quality services for maintaining and promoting the well-being of the seniors. The role of collaboration with service providers in the business sector and the non-profit third sector has been acknowledged on the national level, as well as the importance of responding to actual user needs. In this article we present the results of several data sets gathered in the western Uusimaa region offering different perspectives on well-being services, both the user perspective as well as the service provider perspective. The article gives a snapshot of the present state of well-being services in the region and the way the services of different service providers are orchestrated to form seamless service paths for the seniors to promote well-being. Also further development needs are identified.

Keywords

well-being, services, seniors, collaboration

Introduction

The general trend in Finland as well as globally is towards an aging population. In Finland, the amount of over 65 years olds is estimated to grow from 18% of the population in 2012 to 26% in 2030 (Statistics Finland 2012). Worldwide, it is estimated that in 2025 there will be 1.2 billion people over 60 years old (WHO 2002). To guarantee the well-being of the ageing population, there is a pressure to offer more good quality, effective services that focus on health promotion instead of curative medicine (Finnish Government 2007).

In the traditional WHO definition health is seen as mental, physical and social well-being (WHO 1948). The concept of well-being on the other hand is wide and hard to define (Siltaniemi & al. 2011). Based on extensive empirical analysis Rath and Hartner (2010) define well-being consisting of five elements: how you occupy your time, your social relations, financial aspects, physical health and engagement in the community.

In Finland the general level of well-being has improved over the years (Eronen et al. 2012) and generally the adult population is satisfied with their well-being. According the report of Health Behaviour and Health among the Finnish Elderly, coping in daily activities and functional abilities of Finnish seniors have improved over the years as well the feeling of security. Low income, memory disorders and becoming dependent on others' help are reasons for feeling insecure (Holstila et al. 2012).

With old age the subjective experience of well-being declines as the functional abilities decrease and the prevalence of illnesses increases (Siltaniemi et al. 2011). Vascular diseases are the most common cause of death in Finland causing 39% of deaths in the year 2012 (Statistics Finland 2013). In Tuikkala's research (2011) 87% of the above 74 year olds used medication for a heart condition (e.g. for high blood pressure). In the context of the elderly population, health promotion is about maintaining the health condition and ability to function. Until the age of 75 health promotion is similar to the middle aged population, from the age of 75 onward it is important to acknowledge the personal differences in the health status and from the age of 85 onward maintaining and enhancing the ability to function is the key issue. In old age, also the role of basic risk factors changes with e.g. low blood pressure and cholesterol levels being connected to a higher mortality risk (Tilvis 2009.)

With a focus on health promotion well-being services must be defined broadly. Besides health services and social services, well-being services include also services that support mental well-being (Siltaloppi & Puhto 2010) and functioning in the everyday. Among elderly people mental well-being is a very important part of the quality of life with an effect to the process of ageing. This period of life includes losing family members and friends, loneliness and social isolation. These are linked to physical and mental well-being and lead to the need for social support. (WHO 2002.)

In Finland, the municipalities are responsible for the organization of primary health services and social services for their residents. These services can also be outsourced to the private sector. Private service providers include both for-profit service providers as well as non-profit service providers in the third sector. Private services supplement the public services and the use of private services can be supported by the municipality by e.g. service vouchers. The use of private services is on the rise in Finland. In 2009 the expenditure of private services in health and social services were 27% of the whole 21.2 billion euros (Arajärvi & Väyrynen 2009).

The for-profit service providers offer an array of alternatives for the seniors with purchasing power. As another alternative are the non-profit actors in the third sector who may be seen as innovative developers of services and supportive activities who know their members' and target groups' needs and reality. In the non-profit service production effectiveness and profit seeking have not been the main objectives. Instead, they have worked as a channel for social action giving an opportunity for the citizens to bring forth their own needs and viewpoints. (Ministry of Justice 2005) The role of voluntary work in associations needs to be acknowledged in promoting wellbeing, both from the point of view of the one doing voluntary work as well as the one taking part in the activities of the associations. According to the 2009 Time use survey of Statistics Finland 29 per cent of the population aged 10 or over had done voluntary work in the preceding four weeks.

The law requires the municipalities to collaborate with other actors in the region in service production (L980/2012).The national quality recommendation aims at supporting the municipalities in developing services for older people in collaboration with other service providers (Ministry of Social Affairs and Health 2013). The goal is to guarantee healthy living and a good functioning ability in old age by structuring the services to support e.g. participation and good timing in service delivery. The municipalities must have an implementation plan on how to support the well-being of the elderly population. They also have to collect feedback from the service users, relatives and the personnel for service evaluation (L980/2012).

Collaboration has benefits for the service users in offering good quality services but working in cooperation also has benefits for the service providers. On the general level, organizations working in networks gain access to information which may lead to adapting good practices as well as developing new innovations. Networks also affect performance and business survival. (Brass et al. 2004) In the service sector, in Evanschitzky's study (2007) service networks gained competitive advantage especially through shared resources. However, there are also challenges in collaborating. Thompson et al. (2009) define collaboration as working for shared goals that require managerial structures for decision making and administrative structures for coordination. Collaboration also requires trust and shared norms as all parties also have their own organizational goals to pursue;

mutuality is expected. In the study by Grudinschi et al. (2013) on challenges for collaboration in elderly care the challenges were managerial and administrative by nature, for example challenges such as uncertainty about the activities of the other organizations, fragmentariness of services, limited resources and unclear rules, the weak role of the voluntary sector and planning the continuity of collaboration.

The national guidelines emphasize both the meaning of collaboration in service production as well as taking the user perspective into account. In this article we want to consider these both aspects in the context of services for the seniors in the western Uusimaa region. The article presents results gathered in two projects of Laurea University of Applied Sciences (Laurea UAS). The first project Proactive Care and Prevention (2008-2010) focused on the heart and diabetes patients' care pathways. The second, the ERDF funded project Pumppu (2011-2014) focuses on developing well-being services in a citizen centric manner with a multiactor perspective. The subproject of Laurea UAS is focusing on health promotive services and services that prevent marginalization in society in the western Uusimaa region. The region consists of seven municipalities of which two (Karkkila and Vihti) have been the case area for the development of services related to heart health.

Materials and methods

In this article, we study the present state of well-being services in the Western Uusimaa region from two perspectives: from the experiences of the seniors in the region and the experiences of the service providers especially in relation to their ways of collaborating and cooperating. These perspectives may be presented as the following research questions:

1. How do the seniors in the Western Uusimaa region evaluate local well-being services?
   - What are the services that they themselves use?
   - What kind of services would they appreciate?
2. What is the role of the different service providers (public and private) in the region?
   - What kind of cooperation and collaboration does there exist between the service providers?

To answer the research questions we are analyzing several data sets that have been collected in the region in 2010-2013. The data sets are described in the table 1 below.

Table 1. List of data sets.

Description of respondents	Data collection	N	Year	Area
1. Senior citizens in a well-being event	Survey	73	2013	Vihti
2. Seniors with a heart disease	Interview	13	2013	Vihti and Karkkila
3. Board members of heart associations	Survey	18	2010	Lohja, Vihti, Karkkila
4. Business sector and public sector well-being service providers	Survey	77	2012	Western Uusimaa region
5. Business sector well-being service providers	Interview	23	2012	Uusimaa region
6. Public sector nurses and practical nurses at the Federation of Municipalities Karviainen	Interview	10	2012-2013	Vihti and Karkkila

The data sets 1 and 2 focus on the user perspective on well-being services and the data sets 3 to 6 on the service provider perspective. As the data sets have been collected in two projects with a shared focus on heart health, there are also heart specific data sets in the compilation, namely data sets 2 and 3. As vascular diseases are one of the national diseases in Finland affecting the life of most Finnish seniors, the heart health related data sets offer a valuable insight to the everyday life of the seniors in the region.

The first data set is a survey for senior citizens that was conducted for the participants of a well-being event in the municipality of Vihti, with 73 respondents. The event was arranged by the public health and social service provider in Vihti and the neighbouring municipality of Karkkila, the Federation of municipalities Karviainen in cooperation with other actors in the region, including Laurea University of Applied Sciences. The second data set consists of 13 interviews for seniors with a heart disease in the municipalities of Vihti and Karkkila. The data set is discussed in this article based on the analysis by Hantunen and Silta-aho (2013) in their thesis.

The third data set is a survey conducted for board members of heart associations in three municipalities in the western Uusimaa region: Lohja, Karkkila and Vihti. The data set has been analysed in the thesis by Laakso and Niemi (2010) and in a project summary report by Tuohimaa, Rajalahti and Meristö (2012). The fourth data set is a survey for private and public well-being actors in the western Uusimaa region that has been reported by Saario (2012) in her thesis. Of the respondents 62 were business sector actors and 15 public sector actors. The fifth data set consists of 23 interviews for actors in the business sector that have been gathered in the Uusimaa region. And finally, the sixth data set consists of 10 interviews for nurses and practical nurses in the health center and home care units of the Federation of Municipalities Karviainen in Karkkila and Vihti.

Our purpose in this article is to analyse the data sets in relation to the two research questions described above. Data sets one and two will answer to the first research question of evaluating the well-being services from the perspective of the senior citizens in the region. They will also give the user perspective to the second research question about the role of different service providers in the region. With regard to cooperation and collaboration between the different service providers, the answers will be derived from the data sets 3 to 6 from the public sector (data sets 4 and 6), from the for-profit business sector (data sets 4 and 5) and the non-profit third sector (data set 3) perspectives.

Results

According to the survey for the seniors (data set 1), 30% of the respondents felt that their health was on a good or a very good level, 60% that it was on a moderate level and 10% that their health was poor. 78% were satisfied with their situation in life. The 22% that were not satisfied, had illnesses or disabilities that complicated daily life or had problems in their personal life with feelings of loneliness or lack of emotional support.

The respondents had differing profiles in using health services ranging from 15% using health services less than once a year to 7% using health services at least 9 times a year. 75% of the respondents were satisfied with the amount of health care services that they had been using. Besides health services, the respondents used sports services and services of associations and clubs the most; about half of the respondents used them weekly. On the whole, 82% of the respondents were satisfied with the services that they used. The dissatisfied mentioned problems in mobility, the lack of services in their own neighborhood and bad experiences in encounters with care personnel. The respondents wished for more sports services such as a new swimming pool and more help available at home. Overall, the respondents wished that services would be available closer to home and easy to access.

In the survey (data set 1), well-being services were defined broadly and the respondents acknowledged the role of e.g. sports facilities in supporting well-being in old age. In the interviews for seniors with a heart disease (data set 2) (Hantunen and Silta-aho 2013) the interviewees focused mainly on public health services.

Most of the 13 interviewees in data set 2 considered the health services adequate in their municipality and thought that the services supported their coping in daily life. Some thought that the services were inadequate with too long waiting times and resource shortages. Some used private health services which they thought were easier to access and more flexible. Knowing the care personnel was considered as important.

The interviews give the impression that the public health services are the first services that come to mind when thinking about well-being services and other services are not considered as central. For instance, the activities of the local heart association were not considered as services for heart patients until specifically asked about, although many considered the activities as an important part of their everyday life.

When asked about how to improve the services in their municipality, the interviewees mentioned more easy access services and the importance of exercise in keeping up their health. Some wished that the municipality would take more responsibility of the services that at the moment were organized by associations in the region. The role of associations in offering peer support was considered important and more cooperation between the municipality and the heart association was longed for.

With the Finnish welfare state tradition it may be that the role of the municipality as the organizer of services is what the residents want. With resources shortages and cuts in service offerings in the remote districts the need to find new solutions in service production is evident, although the public service option is preferred. With a network of service providers the well-being of the residents may be easier to keep up (Kokkola et al. 2007).

What about the service provider side opinions about the present state of the well-being services in the region and the level of cooperation? In the data sets 3 to 6 we will turn to the service provider opinions. In the analysis, we were interested in finding what kind of cooperation and collaboration there exists between the service providers and what kind of expectations there are for further development. Within the public health care provider collaborating may be difficult even within the organization as there are many branches and operating units. As special health care is organized as a separate organization covering the hospital district, this brings about another seam in the care process of an individual client. To support well-being, collaboration is needed also with other sectors than health, such as sport services and social services. As the health services may be organized in collaboration with several municipalities, this can make it quite a mix even within the public sector service providers. To add the private sector service providers to the picture makes it quite a bundle to orchestrate. In Finland, data system development is invested in to make collaboration easier with e.g. a common patient record archive.

The third sector perspective to service production in this study is based on a survey data for the board members of heart associations in the municipalities of Lohja, Karkkila and Vihti (data set 3). In the survey, 17 of the 18 respondents considered their associations' role in the care pathway of the heart patient as important. They described their associations' role mainly as providing information and peer support to the heart patients. In their opinion, the heart patients get information about their activities from other patients, from the hospital, from the media or from leaflets. Still, 8 respondents thought that the heart patient does not get information on their activities.

Twelve of the respondents considered that their association collaborated with other actors, primarily with the third sector (11 respondents). Five respondents acknowledged doing cooperation with other actors, too, with the health center, the hospital or home care. Collaboration consisted of different events and shared activities but also getting facilities and financing. Only two of the respondents answered no to the question whether they would prefer doing more cooperation with other actors in the future. However, in an open question only four gave an example of with whom they might have more cooperation: other associations, the hospital, the health center and the pharmacy. In the survey, collaboration or possible future collaboration is described in very few words. With nearly half thinking that the heart patient does not get information about their activities, more cooperation might be in need.

A survey was conducted to the actors in the health and well-being sector in the western Uusimaa region (data set 4) with 62 business sector respondents and 15 public sector respondents. 82% of the business sector respondents were entrepreneurs out of which 59% were working alone. Most of the business sector respondents were operating in health and social services. The public sector respondents, albeit few in numbers, represented 6 of the municipalities in the western Uusimaa region. They worked mostly at the management level in health or social services, sports services or education of the municipality.

The respondents in the data set 4 were asked with whom and what kind of cooperation and collaboration they had. In the answers, few general trends emerged. In the business sector responses the common line of collaboration was the case where the respondents had clients whose every day issues had to be taken care of. The respondents were typically working in some housing unit. Another typical line of collaboration was the case where the business sector actor received clients or offered services to the public sector health care providers. Cooperation between two business sector actors was typically about referring a client to a colleague in situations where one could not serve the client oneself or working with shared clients. About half of the business respondents collaborated with the public sector and one third with other business sector well-being service providers. Only one in five of the respondents collaborated with associations and other non-profit organizations. New cooperation was mostly wished for with the public health care sector and other private well-being service providers.

The 15 public sector respondents in data set 4 had quite versatile reasons for collaboration within their own organization ranging from shared clients and being part of a multiprofessional team to having shared administration, projects and plans. With the special health care provider the collaboration was primarily about shared clients. As the respondents were mainly on the managerial level, their perspective on doing cooperation was quite different to the business sector respondents who were often entrepreneurs in micro companies. The public sector respondents had more cooperation with actors like the church, the employment office and schools than the business sector respondents. Cooperation with the public sector actors ranged from 8 to 12 of the respondents depending on the actor. Cooperation with the business sector was most often about outsourced services and shared clients. Cooperation was most common with companies offering caring services, with whom eight of the respondents collaborated. Seven of the respondents were cooperating with patient associations. The role of patient associations was to work as the representatives of the people in giving feedback and taking part in making plans. New cooperation was mostly wished for with the municipal primary health care organizer. Those who wished for more collaboration with business sector actors were interested in offering more services to the residents in the area. In other words, collaboration with the business sector was considered as a way to improve the service level in the region.

In the interviews in the data set 5 conducted to private business sector health and well-being service providers in the region (with 23 interviewees) the collaboration with other service providers was considered as important to guarantee a seamless and flexible service path and continuity of treatment to the client. Cooperation was seen as essential to the operations of the service provider at the same time bringing coverage to the enterprise. The collaboration that existed with the public sector was generally considered as good and productive although some felt that the collaboration required that the business partner was active in taking contact. Forums for sharing development ideas were considered important as well as open communication. Also different kinds of events for clients which were organized in cooperation were appreciated as a way of networking with other service providers.

Collaboration with associations was not as common as the collaboration with the public sector. Approximately one third of the interviewees in data set 5 had no collaboration with associations. However those entrepreneurs that collaborated with associations considered it important and easy. For example the entrepreneurs had been lecturers in events organized by associations, which was seen as one way of enlarging the customer base. Entrepreneurs thought that the actions of the associations supported their own operations and that association offered services which were impossible to offer by the business or the public sector. The knowledge and benefit of service users' opinions was also mentioned.

Ten of the interviewees in data set 5 had no or only minor collaboration with other entrepreneurs. However, those that did considered it important in developing their business and securing their customer base. Cooperation was also seen as a way of offering good customer service for the client. Fear of competition and unwillingness were seen as barriers to cooperation. More collaboration was hoped for, for example joint trainings and forums for coming together and networking.

In the interviews for the public sector nurses and practical nurses in data set 6 there were specific care pathways designed for the clients. There were experts that the clients could be referred to if needed both in the primary as well as special health care. The nurses in the health centre worked as pairs with doctors and the nurses and practical nurses in home care as teams. Collaboration with the municipal sports services were also good with clear procedures on how to proceed.

However, also the interviews with public sector nurses and practical nurses suggest that the collaboration with associations is not regular. Although many kinds of contacts with the associations exist, the cooperation seems to be based on personal relations, with some nurses being active in associations while others not. In the health centre, some sought information about the activities that associations offer, mainly on sport alternatives, but others thought it the responsibility of the associations to make the contact and inform about their activities. This implies that the role the associations may have in enhancing the well-being of the clients of the health care provider is not appreciated as much as it might be. The nurses and practical nurses that worked in home care on the other hand were quite familiar with being the advocates of their clients in a variety of every day problems, including finding social support for the lonely and the ones with limitationts in their mobility. The problem was that volunteers to come visit the elderly living in the periphery were hard to find.

In the nurses' appointments at the health center collaboration issues with the business sector were rather minimal. The nurses may get clients that have gone to the doctor in the private sector, which brings about the problem of not having the health records available. Otherwise, cooperating with the business sector is almost non existent. In the Finnish context, the actors in the public sector are often very cautious about the limits set by the legislation; the public sector cannot favor any business sector actor and therefore have to stay neutral with regard to the alternatives available in the market. In the interviews for the home care personnel, collaboration with the business sector actors was more common. This was typically due to outsourced services such as the security and cleaning services and patient transport services.

Conclusion

According to the results the seniors in the western Uusimaa region evaluate local well-being services quite positively. Public services seem to be the services associated to well-being the most, although besides health services aspects such as exercise and mental well-being are appreciated, too. With relation to health, some of the interviewed heart patients had turned to private health services but most would prefer using public services, as they are nevertheless paid for through taxes.

Sports facilities and possibilities for exercise were seen as important for the well-being of the senior citizens. Wishes for service development point to the fact that services should be easy to access and close to home. Solutions that bring services accessible to the ones with limits in mobility are high priority in an aging society wishing to care for the elderly in their own homes.

The role of the service providers in catering services for the seniors vary. As mentioned, the public services form the basis for health with distinct care pathways and work distribution between the primary and special health care. The role of associations in offering peer support and activities in the everyday is important, too. The services of the business sector supplement the other sectors. Through outsourcing they may have an important role in the life of a senior citizen with impairments in functionality.

Considering how the different service providers collaborate and how the service offerings are orchestrated in the region, the picture is rather narrow. The collaboration between the public and the business sector seems to be mainly based on outsourced services and shared clients. New structures for enhancing seamless service paths for the clients might be of use. For instance, the physiotherapy unit in the Federation of Municipalities of Karviainen has been proactive in developing cooperation networks with local for-profit sports services. This way the client

preferences may be easier to fulfill as to where to exercise, at the same time offering also publicly funded guidance by the physiotherapist.
Considering the collaboration with the non-profit third sector actors, new perspectives might be of use, too. In the data sets on the business sector service providers (datasets 4,5) the cooperation with the public sector and the business sector service providers was considered as important whereas collaboration with associations was not as common. Also the interviews with public sector nurses and practical nurses (data set 6) suggest that cooperation with associations is not standard procedure but based on personal relations. Challenges exist even working in cooperation within one's own organization and with the special health care provider. The associations on the other hand were collaborating mainly with other associations and third sector actors. The role the associations may have in enhancing the well-being of the residents is not appreciated as much as it might be. According to the interviewed heart patients the role of the heart association was important in offering peer support. This should be acknowledged and taken advantage of in designing future services using the whole resource potential of the region. However, as the home care personnel pointed out, the services of the associations as they are generally based on voluntary work do not necessarily reach the most remote districts. Designing the work distribution of the different actors and service providers in the region and appreciating their strengths and limitations is crucial and requires coordination. In the end, easy access services at home or close at home that promote the functional abilities of the seniors form the basis for healthy aging.

One alternative to offering services at home are solutions based on information technology, such as two channel interactive tv systems (Raij and Lehto 2008) or personal wellbeing navigators (Meristö et al. 2010). Guaranteeing that the seniors have access to the technology needed and skills and motivation for its utilization is imperative for technological aids to be applicable to seniors (Viherä 1999). Accessibility and skills can be improved but the motivational side is harder to affect. This attitudinal side with regard to electronic services has been investigated in the western Uusimaa region population by Hauhia (forthcoming) in his thesis. In Sarapisto's thesis (2009) on the retirement phase service and information needs of residents in the western Uusimaa region the respondents generally favored paper documents although the younger respondents were more positive towards electronic alternatives. In the heart patient sub population the thesis by Jääskelä and Karstila (2012) on the other hand highlight the importance of technological skills as the computer illiterate interviewees in their study were reluctant to use technological aids in their care.

In the end, listening to and respecting the wishes of the seniors is the most important viewpoint to service development. Only services that respond to the actual needs and preferences of the seniors can have a proactive, health promotive effect on the seniors' health and wellbeing. Listening to the assets and health resources of the seniors brings a new perspective to service production in finding what brings about positive effects to the seniors in their own experience in their every day living environments (Hollnagel and Malterud 2000).

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Acknowledgement

This article has been written as part of the Pumppu project funded by the European Regional Fund. We would like to thank Minna Luoto and Jari Kämäräinen at the Federation of Municipalities Karviainen for the collaboration in the project and the comments on the article manuscript. We would also like to thank the staff and students of Laurea University of Applied Sciences that have participated in the gathering and the analysis of the empirical data and all the partners in the project.

About the Authors

Hanna Tuohimaa (M.Soc.Sci.) works as a project specialist in Laurea University of Applied Sciences, Lohja unit. She works in projects related to wellbeing. She is also a doctoral candidate in sociology at the University of Turku Graduate School. She is studying the interpretations of responsibility in relation to wellbeing and health promotion.

Liisa Ranta has been working as an entrepreneur in health care in 1989-1997 and a nurse in 1992-2009. After 2009 she has been (MNSc) senior lecturer in Laurea University of Applied Science (UAS) where she has worked also in projects and developed learning environments for the nursing students.

E-Health Solutions as an Opportunity for Empowering Responsibility

Hanna Tuohimaa, Outi Ahonen, Tarja Meristö & Elina Rajalahti, Laurea University of Applied Sciences, Finland

Abstract

In this paper ways to promote an active, take-charge attitude towards health and wellbeing are sought by empowering the citizen through the use of e-health solutions. Empowerment is about enhancing people's abilities to solve their own problems and feel in control of their lives. eHealth solutions provide an opportunity to enhance empowerment when they are citizen centric and offer solutions to real problems. This guarantees also motivation for their use. However, also the access to technology and competence for its use should be considered.

The Coper is a concept for a citizen-led information system that works as a navigator guiding the individual in her daily endeavours. In the Pumppu project funded by the ERDF the benefits of the Coper concept for the care pathway of heart patients have been studied based on a group interview of 4 heart patients and on previous empirical data on the problems on the care pathway in Western Uusimaa in South Finland.

At present the heart patients see the care process as fragmented and uncertain with discontinuities and gaps in the information flow. Elements of the Coper such as the provision of information and guidance on the care pathway would be of relevance for the patients. With the Coper concept self-management and the care offered by multiple service providers can be merged giving a holistic picture of the life situation and the care pathway needed for health improvements. As a result, take-charge responsibility towards one's own health and wellbeing can be better achieved.

Keywords

empowerment, responsibility, e-health

Introduction

A responsible citizen takes charge of her wellbeing as much as her life situation, resources and competencies permit (in line with Waller 2005). In this paper ways to promote an active, take-charge attitude towards health and wellbeing are sought by empowering the citizen. The empowering opportunities of e-health solutions are discussed, with an emphasis on citizen centric e-health solutions such as the navigator-like Coper concept (Meristö et al. 2010) which is analysed more closely in the context of cardiovascular disease.

The aim of the paper is to describe, how the Coper concept can offer opportunities to empower citizens in taking responsibility of their health and wellbeing. Also the critical points and key elements of the Coper on the care pathway of heart patients are discussed.

Empowerment as the framework in the care of cardiovascular disease

Atherosclerotic cardiovascular disease (CVD) is a chronic disorder developing insidiously throughout life and often progressing to an advanced stage by the time symptoms occur. It remains the major cause of premature death in Europe. CVD is strongly connected to lifestyle. The World Health Organization (WHO) has stated that over three-quarters of all CVD mortality may be prevented with adequate changes in lifestyle. (Perk et al. 2012)

Increasing patient adherence is an important part of heart failure self-care management. Increasing patients' knowledge about the goals and expected effects of advice on behavior remains a first-line intervention, but is often not enough. By assessing a patient's personal situation, interventions can be tailored to the individual patient. (Jaarsma et al. 2012.) Healthcare providers can help patients engage in optimal self-care by identifying the source of barriers (Baumann 2012). Continuous assessment is needed to increase behavioral changes in patients with heart failure. (Jaarsma et al. 2012.)

One line of engagement in self-care is the emphasis on empowerment, i.e. enhancing people's abilities to solve their own problems and feel in control of their lives (Gibson 1991). As motivation is influenced by perceived competence as well as perceived autonomy in choosing to act (Vallerand 1997), empowerment and motivation are intertwined. Evidence on the effectiveness of empowerment to enhance wellbeing is abundant (see e.g. Wallerstein 2006).

Measuring empowerment outcomes depends on the situation and on the level of inquiry. In the micro level empowerment outcomes may include e.g. perceived control, competence and efficacy, problem solving and decision making skills and actions taken to make a change. (Zimmerman 1995.) On the community level empowerment outcomes might include evidence of pluralism, new organizational coalitions and better access to community resources (Perkins & Zimmerman 1995).

Choices in the everyday are crucial for either healthy or unhealthy living. Empowered individuals are better equipped to making good choices. With a forward looking interpretation of responsibility as a take-charge attitude towards health (Waller 2005, Cappelen & Norheim 2004), instead of a backward looking concept of blame and accountability, responsibility may be pursued within the empowerment framework.

e-Health in Finland

In Finland national eHealth policies and strategies are focusing on patients information systems and My eHealth records. The National Development Programme for Social Welfare and Health Care programs (2012-2015) aims at adjusting the information and information systems so as to support clients and professionals. The main goal is to organize social welfare and health care structures and services in a client-oriented way. The implementation of the National e-Archive of Health Information (KanTa) is one of the key elements of e-health development in Finland. It is phased so that the health care organizations must connect to the national information service system by the year 2014. (KanTa 2012.) The KanTa model is described briefly in the next section before focusing on the Coper concept.

The National e-Archive of Health Information KanTa

The KanTa architecture is a system of electronic national healthcare services and its administrative model. The Patient Records Archive is a healthcare service data system in active use, which allows centralised electronic archiving of patient records and long-term storage of the data. The archive plays a central role in passing information between healthcare organisations and operational units as the data is in a technically uniform format. A national patient data management service has records of patient consents to disclose information and possible refusals of disclosure, together with cancellations of consents and refusals. The Patient Records Archive log and control services help to ensure that patient records are used in compliance with data security and legislation. All uses and disclosures of patient records are entered in a log which permits ex-post control. One part of The KanTa architecture is the Prescription Centre and Archive. (KanTa 2012.)

In the Kanta architecture, My Health Information is a personal online service for the citizens. In the service, people over 18 years of age can view their own electronic prescriptions and patient records and print out a summary of their electronic prescriptions. Clients can also request a summary of their electronic prescriptions. (Kanta 2012.)

The Coper as a citizen-led solution for eHealth

The Coper is a concept for a citizen-led information system that works as a navigator guiding the individual in her daily endeavours, especially concerning health and wellbeing (Meristö et al 2010). It integrates the official service provider led information systems into a tailored one stop service platform organized around the needs and desires of the individual in her present life situation. It also combines official data with self-reported monitoring data on health issues and makes it possible to manage all relevant issues in life seamlessly and with cooperation of all the needed service providers locally, regionally or even globally.

As a visionary concept the Coper is a holistic model of an ideal state of integration. So far, the concept has been piloted only partially in the retirement phase and with families having a baby (Meristö et al. 2010). In the Pumppu project funded by the ERDF the Coper concept is applied to the care pathway of heart patients.

Real life partial solutions can be found in e.g. personal health record solutions. In the Finnish context the national e-archive of health information (KanTa) is a step towards such a system. However, with the Coper the health process is turned around with the individual as the process owner for whom the services are organized. The Coper concept gives the individual more control in her life as it provides her with a picture of the present state and the future possibilities in taking care of her own health and wellbeing. Therefore we see the Coper concept as a viable it-based solution to empowerment.

Empowerment through eHealth solutions – empirical findings

The empowering possibilities of the Coper concept are investigated based on a focus group interview of 4 heart patients with an average age of 70 years on technological aids and on the problems on the care pathway (Jääskelä & Karstila 2012). Also a survey for 337 retirement aged residents about their information needs and electronic service habits is utilized (Sarapisto 2009) and 66 interviews of heart patients of their experiences on their care pathway (Tuohimaa et al. 2012).

In both the interview cases the heart patients felt in need of more information especially in the rehabilitation phase, e.g. on symptoms after the operation, on medication and it's side effects and on equipment available for home use. They also needed information on safe exercise options and other practical guidance. Providing information in all the stages of the caring process would then be a practical element of the Coper.

The interviewees felt in need of a constant dialogue with the health care providers. More support was needed to cope with everyday life. Friends and family members were crucial in offering support. It-solutions cannot fully replace face-to-face interaction. As a complementary option solutions resembling the face-to-face encounter such as the wellbeing TV have gained good feedback from the elderly (Liesmäki 2011).

Especially in the focus group interview the care pathway was considered as fractured with a lack of continuity. With the Coper concept self-management and the care offered by multiple service providers can be merged into a holistic picture of the life situation and the care pathway needed for health improvements. Working as a navigator the Coper would be one possible solution for guiding the individual in the care process.

Regardless of all the benefits of implementing e-health solutions, also questions of accessibility to technology and competence for its use should be considered (Nurmela and Viherä 2004), especially when empowerment is pursued.The focus group interviewees had differing experiences in using it-equipment and most were hesitant of their abilities to use such tools. The most familiar it-equipment was the mobile phone but anxieties about malfunctions made interviewees worried. In the survey data (Sarapisto 2009) the younger retirees were more interested in using it-tools in the health care setting than the older ones. Therefore, it is possible that in the years to come, the acceptance of e-health solutions in home use will improve, especially if positive experiences cumulate.

Discussion

At present the heart patients see the care process as fragmented and uncertain with discontinuities and gaps in the information flow. Elements of the Coper such as the provision of information and guidance on the care pathway would be of relevance for the patients. Better control in life is a basic element of empowerment and hence fundamental in the framework for empowering responsibility.

However, the interaction preferences and abilities for technology use must be acknowledged. eHealth solutions should not be the only option. Instead, they should be seen as a complementary solution to face-to-face communication and paper documents. eHealth solutions provide an opportunity to enhance empowerment only if they are citizen centric and offer solutions to real problems on the care pathway, listening to the needs and preferences of the potential users. This guarantees also motivation for their use.

With the Coper concept a holistic picture of the life situation and the care pathway needed for health improvements emerges. Also health promotion and prevention can be seamlessly integrated into the care pathway. Working like a navigator the Coper can guide the individual in her decisions for a healthier life style. The critical point is to wake the interest in health and wellbeing before anything happens. The actual care process can be supplemented with a tailored set of support and information. Also the use of the services of public, private and third sector service providers is made easier with the Coper. The Coper provides the individual new possibilities to participate in decision making. Therefore the Coper concept has potential in producing empowerment if implemented with sensitivity for individual needs and preferences. As a result, take-charge responsibility towards one's own health and wellbeing can be better achieved.

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About the Authors

Hanna Tuohimaa (M.Soc.Sci.) works as a project specialist in Laurea University of Applied Sciences, Lohja unit. She works in projects related to wellbeing. She is also a doctoral candidate in sociology at the University of Turku Graduate School. She is studying the interpretations of responsibility in relation to wellbeing and health promotion.

Outi Ahonen (MNSc) works as senior lecturer in Laurea University of Applied Science, Lohja unit. Previously she has worked as a nurse in 1989-2002. Her interests include nursing informatics and development work. She has published papers in national and international journals and books. She is a member of the national development group of nursing documentation.

Tarja Meristö (Dr.Sc. Econ.) is a corporate futurist and works as a principal lecturer (wellbeing and future business models) at Laurea University of Applied Sciences, Lohja unit. She is leading the team of FuturesLab CoFi at Laurea. She is specialized in scenario planning and visionary leadership with 35 years' experience of different research and customer projects in the field of futures studies.

Elina Rajalahti (MHSc) works as a principal lecturer in Laurea University of Applied Sciences, Lohja unit. She is interested in research and development work in all areas of health education, health promotion and well-being. She is also involved in a research group that is focusing on health and nursing informatics and healthcare information technology.

Mobile Healthcare Simulation Center – Smart Service Solution

Annukka Puotiniemi, Susanna Tinnilä, Seija Paasovaara & Jorma Jokela,
Laurea University of Applied Sciences, Finland

Abstract

Laurea University of Applied Sciences Hyvinkää is launching a Mobile Healthcare Simulation Center Project. The aim of this smart service solution project is to develop and produce a mobile unit, which can ultimately be transported to and utilized in countries, where healthcare is in early development stages, or where resources are poor. The vision of the project is that the use of the mobile unit can offer high quality healthcare training at a fraction of the cost of building a permanent facility. This ICT-utilizing innovation has transformative potential, and will be a prime example of a micro-level Living Lab.

The article will draw from evidence and experience from systems that have already been implemented, both within the European Network of Living Labs (ENoLL) and further afield. The article will further outline the proposed schedule and phases of the Mobile Healthcare Simulation Center project, the technical aspects of it, and the resources needed to realize the project. Furthermore, the article will explore and highlight the local, national, and international social and economic benefits of a Mobile Healthcare Simulation Center.

Keywords

Mobile healthcare simulation center, national, international, public, private sector partner

Introduction

Laurea University of Applied Science Hyvinkää unit in the Metropolitan Helsinki area of southern Finland is a Campus for Simulation, Innovation and Interaction (C-Simac). Hyvinkää multidisciplinary campus focuses on social development and social responsibility. This means research-based interaction with national and international companies, organizations and the public sector.

Learning by Developing (LbD) is Laurea's innovative pedagogical operating model. It was started in 2006 by Laurea University of Applied Sciences and had the distinction of being named as a center of excellence by the Finnish ministry of Education in the same year. In it, the three statutory tasks of Finnish universities of applied sciences – pedagogy, regional development and R&D – are merged into a single process of creating new expertise and knowledge. Learning is creative, and it is based on authenticity, research-orientation and face-to-face encounters.

In the last quarter of 2013 and early 2014 Laurea Hyvinkää launches a Mobile Healthcare Simulation

Center Project. The vision of the project is that the use of the mobile unit can offer high quality healthcare training at a fraction of the cost of building a permanently built simulation facility. This ICT-utilizing innovation has transformative potential for the future, and will be a prime example of a micro-level Living Lab.

The project pilot testing plan is scheduled for 2014, with the first phase of the project scheduled to be concluded in November 2014. Initially the Mobile Center will be taken to Russia and the Baltic countries at the beginning of 2015, with the project aiming to conclude in 2015. Laurea has estimated the total budget, and is currently in the process of seeking funding for this project. The project is intended to be carried out in collaboration with national and international public and private sector partners.

Mobile simulation units have already been implemented in Scotland and Canada, and Missouri, Nebraska and South Dakota in the United States. These mobile simulation units have been shown to be beneficial to the improvement of health. (Cosh, 2012; Regional EMS Foundation, 2004; University of Missouri, 2013; University of Nebraska Medical Center, 2013; University of South Dakota, 2012.)

The aim of this smart service solution project is to develop and produce a mobile unit, which can ultimately be transported to and utilized in countries, where healthcare and training associated with healthcare, especially simulation-based learning, is in early development stages, or where healthcare and training resources are poor.

The Need for a Mobile Healthcare Simulation Center

According to the Red Cross World Disaster Report of 2013, in 2012, the situation globally was that fewer people than ever before died as a result of natural disasters. Although the absence of major natural disasters was a contributing factor, technological advances were also seen as a key factor. This is specifically the case in technically advanced environments, such as large cities, but also true for rural areas. The advancements in technology have enabled improved communications and information exchange, resulting in better connected communities that are more involved in humanitarian action than ever before (International Federation of Red Cross and Red Crescent Societies, 2013). The humanitarian technology network Crisis Mappers lists live simulation as one of the technologies it leverages "to power effective early warning for rapid response to complex humanitarian emergencies" (Meier, 2014). The International Federation of Red Cross and Red Crescent Societies (2014) has estimated in its latest annual report that every dollar spent in disaster preparation, whether through simulations or drills for disasters, saves between 2 and 55 dollars in disaster response and recovery. Being prepared through these means can save not only money, but more importantly lives and livelihoods, if a disaster strikes. National societies of The Red Cross and The Red Crescent have recently organized preparatory training activities in a number of countries, such as in Finland for midwinter storms preparedness and in Tajikistan for floods (Zambello, 2013).

The use of a Mobile Healthcare Simulation Center enables simulation training even in locations where there is no access to appropriate facilities, providing a mechanism to increase the number of institutions and locations with access to simulation training (Clapper 2013). According to the World Health Organization's education guidelines recommendation 5 "Health professionals' education and training institutions should use simulation methods (high fidelity methods in settings with appropriate resources and lower fidelity methods in resource limited settings) in the education of health professionals" (Transformative Education for Health Professionals, 2014).

Geographically the closest areas to benefit from a Mobile Healthcare Simulation Center are Finnish rural areas. As already demonstrated in Scotland, access to a mobile training unit saves local authority budgets, saves personnel's time away from their jobs, and improves the professional skills of healthcare practitioners. The mobile clinical skills unit in use in Scotland was funded by NHS Education for Scotland and is run by the Clinical Skills Managed Educational Network. The simulation unit, launched in 2009, is a 25m2 classroom capable of accommodating up to 16 people. Before the unit was launched, nurses and doctors in rural areas had limited access to training, and training sessions outside their own organization was expensive and time-consuming.

The mobile unit has provided an affordable and convenient means of training staff. By year 2012, the mobile unit had hosted 227 courses for 1 700 healthcare practitioners at over 26 venues. According to the first report, the unit had been in use for 71% of the time. The unit has the resources to provide training in a vast array of situations, such as first aid, clinical assessment, patient care, operation and procedure skill sets, communication skills, and improvement of health. (Cosh, 2012.)

Worth taking in to consideration, as well as the ability to train health care staff, is the positive economic impact of the development and building of the Mobile Healthcare Simulation Center. Quotes for the building of the mobile unit have already been sought from Finnish providers, and the outsourcing of the medical equipment will also be sourced as locally as possible. This will improve the economic conditions and will provide more people with work.

The Simulation Center being mobile allows for the vision of transporting the training unit to other countries. The unit can be moved via road, rail, or by waterways, enabling the use of the Mobile Simulation Center far away from its host location in Finland. There has already been interest in the mobile unit from as far afield as South America. There is a declared interest from medical schools and professional associations from Peru to develop simulation and other innovative strategies as training of health care personnel and undergraduate students.

According to Peruvian National Institute of Health the healthcare priorities that should be addressed are: human resources, child malnutrition, maternal mortality, communicable disease and mental health (Ministerio de Salud, 2014). According to ENDES (Demographic and Family Health Survey) of 2012, the country's infant mortality rate stood at 17 deaths of children under the age of 1 per 1 000 live births, but in the rural regions the rate was about 22. In the same year the child mortality rate was 23 children under the age of 5 per 1 000 live births. 31.2 % of deaths in children under the age of 5 were caused by acute respiratory infections and infectious diseases, and malnutrition accounted for about 18 % of deaths. According to the same document the perinatal mortality rate was 16 deaths per a thousand pregnancies in the third trimester, with a somewhat larger component of stillborn than early deaths. In 2012, 13.5 % of children under the age of five were suffering from chronic malnutrition. The estimate of women who die from complications of pregnancy, childbirth or within 42 days after giving birth was 93 maternal deaths per 100 000 births. The leading cause of maternal death in Peru is obstetric hemorrhage, and its maternal mortality ratio from 2007 to 2011 was 34.9 %, the rural region being the one that accounts for more than 50 % of these deaths. The second cause of maternal death is represented by hypertensive disorders in pregnancy, childbirth and postpartum. (INEI, 2013.) Just addressing these issues, among other factors, related to the need for training of healthcare practitioners, could have great impact on improving the overall health situation of a nation.

From 1980 to 2000 Peru faced an internal armed conflict which, according to the Peruvian Truth and Reconciliation Commission, caused the death of nearly 70 000 people (69 280). The Commission found that large sections of the population affected by violence suffered other forms of psycho-social consequences, weakening their ability to develop and to heal the wounds of the past. (Comisión de la Verdad y Reconciliación, 2014.) The affected people live mainly in the rural and Andean regions where there are deficient health care services. The Mental Health Atlas of the World Health Organization stated that the majority of primary health care doctors and nurses in Peru "have not received official in-service training regarding mental health issues within the last five years" (World Health Organization, 2011). These examples from Peru alone demonstrate the powerful potential a Mobile Healthcare Simulation Center could have in the improvement of health conditions on an international scale.

Closely linked to the international development aspect of the project is the future sustainability of any training undertaken. As well as training health care professionals, the vision is to train future training staff in the countries that utilize the mobile center. This allows the countries that receive training through the mobile center to develop individuals with the means to further train other people in their local area. This will contribute towards an increased humanitarian and professional independency of countries in training health care professionals, empowering these countries and regions in self-sustained improvement and development. The concept of trainer training is already in use in the United Kingdom, at Bristol Medical Simulation Centre, where a two-day course is offered, teaching educators how to use simulators as teaching tools. (BMSC, 2014.)

A mobile training unit will come to its own when being used in various countries and regions, as the level of skills and knowledge expected from healthcare professionals can vary dramatically from one country to another. The Mobile Healthcare Simulation Unit can be customized for each time it is used, according to the users' needs and requirements. (Wanless & Aldridge, 2012.)

Initial Project Plan

Project Aims

One of the key aims of this project is to improve the attainability and accessibility of simulation-based training. This will be realized by the development and production of a Mobile Healthcare Simulation Center. Improved accessibility to training will, in turn, allow for more efficient use of resources, increased multi-professional co-operation and the sharing of specific skills. The project aims for the overall improvement of operating room management and development, including improving patient safety, optimization of operating room time management, improved skills set of operating room personnel, and the development of management, team work and workplace wellbeing. The project also aims to produce an added-value chain of universities and colleges, companies, and healthcare operators. The vision of the project is to extend the use of the mobile unit, not only to national and rural areas but also to countries in Europe, and the rest of the world.

Project Timetable

The project was launched in the last quarter of 2013, and the pilot plan was ready at the end of 2013. The acquisition of equipment was started in 2013. The pilot becomes operational and the testing starts in the first quarter of 2014. Project partners will have access to the pilot in the last quarter of 2014. The first phase of the project will be ready by the end 2014. In the third quarter of 2014 the simulation center will be exported to Russia and the Baltic countries, and the project will be finished soon after.

Technical Details

The mobile simulation center will be built in a trailer with the following approximate dimensions: length 13.6m, height 3.5 – 4.2m, width 2.55m. This gives an internal length of 13.5m, height of 2.2 – 2.9m and width of 2.4m. There's also scope for extendable internal walls, which would give and internal width of 3.5m. The total weight of the unit when fully equipped is approximately 12 tons. The structure of the body is fiberglass, Styrofoam insulation, plywood and fiberglass laminate element. The body is reinforced with steel to support the shelving and equipment fixtures. It has a hydraulic suspension and stabilization mechanism, which can be used during operation. The unit has an independent heating and air-conditioning system, with under-floor heating. It has its own generator, which can be removed during operation if necessary, or connected to an external source. The trailer does not necessarily need its own truck; this can be rented or outsourced. It can also be moved as a stand-alone unit via rail or waterways. (Figure 1.)

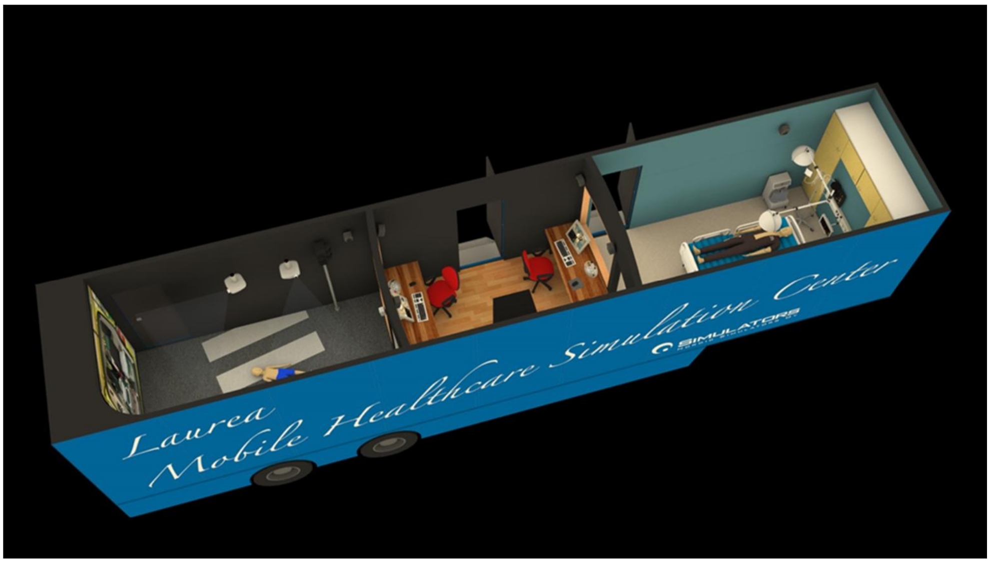

Figure 1. Proposed layout of the inside of the Mobile Healthcare Simulation Center. This layout is capable of housing 2 simulation rooms, with a control room in the middle.

Funding Resources Required

The initial budget, to get the project started in Finland, is estimated at approximately 1 million euros. Laurea University of Applied Sciences is seeking funding resources from within both the private and public sectors (such as the EU Horizon 2020 Project), with project partners providing the staff and expertise. There has already been public sector interest for this project from Spain, Ireland, and Peru.

Conclusion

The project is at a stage, where with appropriate funding, it can be realized within the proposed schedule. Research and statistics show, that there is a real and tangible need for a mobile healthcare simulation center. Once this unit has been built and is operational, it can be transported to various countries that will benefit from this technology. It is envisioned that once the project has an established structure and processes, and has been in operation for a short while, it will be surveyed, and Society for Simulation in Healthcare accreditation will be applied for (SSH, 2014). The mobile healthcare simulation center has transformative potential; it can, and should be viewed as an open innovation environment that can change and adapt as requirements and circumstances inevitably change.

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Acknowledgement

We would like to thank Michan Malca Casavilca (MD, Member of Peruvian Society of Hypertension, Member of Continuing Medical Education Commission of Peruvian Association of Medical Schools, Faimer Institute Fellow 2008, KI Leadership in Medical Education Program 2010) from the Medical School of Universidad Peruana de Ciencias Aplicadas in Lima for providing us with invaluable information on the current conditions regarding healthcare issues in Peru

About the Authors

Annukka Puotiniemi spent the last 16 years in England where she gained an Honours Degree in Communications and worked for several years in the finance industry. She has recently returned to Finland and is now a nursing student at Laurea UAS. Annukka was a co-writer in an article in ISJ - A Special Issue on Security, Safety and Social Responsibility, Vol. 3, No. 1, 2013.

Susanna Tinnilä's background is in Natural Resources, and she is also now a nursing student at Laurea UAS.

Seija Paasovaara MNSc, is director at Laurea UAS´s Hyvinkää campus. She has done pioneer work in Laurea UAS by developing LbD-pedagogy, simulation learning and simulation environments, Peer to Peer –pedagogical model and student entrepreneurship. Her main R&D interests are in development of practice-based learning as well as development of co-creative and innovative workplaces and network. She has recently prepared and publicly defended her PhD dissertation.

Jorma Jokela, PhD, Principal lecturer in Simulated hospital at Laurea University of Applied Sciences, Hyvinkää, Finland and Associate professor for simulation pedagogy in Finnish National Defense University. He became the director of the Simulation Center of Field and Disaster of the Medicine Center of Military 2004. Ministry of Social Affairs and Health: Member of the Advisory Board for Health and Welfare in Emergency Conditions 2003 – 2006.

Digital Business as an Engine for Growth - Finland's ICT Revolution

Taina Tukiainen, Aalto University, Finland

Abstract

Digitalization is playing significant role in increasing productivity and growth, both in the United States and in Finland. In addition, in Finland, the ICT cluster is emerging from a structural reorganization of epic proportions. Whether the state of transition is over is open to debate, however it is clear that innovation is booming.

Keywords

Digitality, innovations, start-ups, gaming, health-care

Boost for ICT start-ups

The Finnish Electronics Industry has a market value of € 17,3 billion (2012). Finland's IT market has a total market value of € 5.7 billion (2012), of which € 1.2 billion was in software while IT services accounted for € 3.0 billion "Over the past years we have seen a real boost in ICT start-ups, specifically when it comes to games, mobile services and related applications - there is a real digital boom happening here in Finland," says Dr. Taina Tukiainen.

From mass production to mass innovation

Today, we should emphasize more to the mass innovation instead of mass production. Digitality enables the new growth for start-ups and for existing businesses. - There are two types of digital success stories: On one hand there are the brand new startups, but on the other hand, the existing businesses renewed. The equally significant are the digital products and services embedded in the operational processes of traditional enterprises that streamlines and renews their existing business.

Start-ups are independent of geographic location

The excellent opportunity for digital businesses is that they are not geography or location centric, instead in other words the geography does not matter, are you in Finland, in Helsinki or Oulu or are you in Silicon Valley.

Stakes get higher on gaming table

In Internet based business a good business idea rapidly becomes successful when timing and channel are right. In digital environment things like country of manufacture have no significance; if the concept is good, a game can take flight around the world like Angry Birds. Grey Area, HeiaHeia, Web Of Trust and Applifier.

The objective is to be achieved with the growt of the dynamic growth enterprises. In Oulu alone some one hundred ICT enterprises are founded annually that possess growth elements. – Best of these grown to reach the international markets.– International growth potential brings about the greatest benefit for the Finnish economy. This growth creates jobs and export income, new Nokias and Googles. Formerly the focus lay in development of technology, currently Tekes emphasizes innovation and growth enterprises capable of internatio-nalization. This increasingly concerns entities formed of equipment, services and software.

– Digitality and software offer considerable opportunities for Finnish enterprises, including the small ones. This field is not owned by the big enterprises alone. In this sense the world has changed greatly. Start-up enterprises can easily initiate international distribution. Funding is increasingly aimed at SME growth enterprises and business development, in addition it is essential to provide networking and internationalization services. – In games cluster you network internationally and learn from others. This is key for the success of the enterprises.

Comprehensive services for growth enterprises

Besides Tekes, product and business development of SME enterprises is funded by private funders like Vision+. The focus is in commercialization of product in a part-sponsor capacity. Vision+ believes that when the product is good, success has a more solid foundation. Vision+ focuses its funding on promising growth enterprises that have fallen between early enterprise funding and several million equity investments, and whose product has potential in the market.

Vision+ investment share is usually 50 000– 500 000 euros. Investors currently include Microsoft, Finnish Industry Investment, FoF Growth, Nokia and The Finnish Innovation Fund, Sitra. In addition to funding and product commercialization Vision+ assists by opening doors and operating as a planner for market entry. – In a creative industry success is built on skill, knowledge and attitude. People get excited about great products. We consider it a pleasure and a privilege to help entrepreneurs and developers to build the products.

Rapid growth for games

The global value of the games industry last year was some 65 billion dollars and the trend is strongly growth oriented, especially thanks to mobile and Facebook gaming. New enterprises flood the market in a steady stream. The games market is spoiled for choice and standing out is the challenge. The Tekes funded growth enterprise, Applifier links games and players on Facebook and elsewhere on the Internet. The objective is to offer the player an easy way to find games, and the games an efficient way to reach new players. Jussi Laakkonen of Applifier says that in certain measures the company is the fastest grown enterprise in Finland. In less than hundred days Applifier reached some 55 million Facebook users. – We now reach over 200 million users, mainly on Facebook, and also increasingly in the open network and on mobile devices. Applifier is one example of how one does not need gigantic marketing budgets in order to succeed. – User acquisition costs exponentially increase for big games companies like EA and Ubisoft, who build a game portfolio and keep the user inside it. Economies of scale make big firms even bigger, Laakkonen says.

The frictionless logic of Internet distribution has also worked for the benefit of Web Of Trust. WOT's browser tool classifies web pages for their reliability, transaction safety, protection of privacy and child safety. The reputational value of web pages is calculated based on recommendations of over 30 million users. A reputational value expressed as a traffic light symbol has already been calculated for some 35 million. Some 50 000–60 000 new downloads are made daily. The big volume has encouraged the enterprise to survey new markets on global scale. – You have to dare to go global right away. It is no use playing in the Finnish district series, Vesa Perälä of WOT draws the line. – Of course, entering new markets also requires more equity, i.e. funding, he stresses.

Rise and shine – Games for Healthcare

Rise and shine Web-based sports community service HeiaHeia encourages small every day choices in exercise habits through recording one's own exercise activity and positive peer pressure. The objective is to grow into a leading international web service for wellness in the workplace. As a motivational tool for activation of sports as a hobby, HeiaHeia has proven a working and popular solution. Working communities have taken ownership of it as a fun and cost-effective way to activate the entire working community and turn absences caused by sickness on a decrease. Collaborating with the Finnish Defense Forces the company also intends to open a net-based exercise service aimed at men liable for conscription, MarsMars.fi. The aim is to motivate all levels of exercisers prior to conscription under lion pages.

Gemification for social problems

Firms have fairly well counted down the fact that when people start to exercise it has a positive effect on absences. The spearhead in many companies are the employees, whose exercise habits leave room for improvement, Jussi Räisänen of HeiaHeia explains. Business potential is fairly wide. Räisänen refers to the estimate by UKK Institute, that the effects on non-exercising are counted in billions of euros in Finland alone. – And in the United States socio-economic diseases cost a thousand billion dollars in loss of productivity.

Also Mikko Kosonen, the President of Sitra believes in the power of health innovations. He sees significant opportunities for growth for start-ups and big enterprises alike in solutions to not only ecologic but also social problems. – We need to find more efficient and citizen- oriented solutions in areas like preventive healthcare. He estimates that the strong Finnish games industry can be made party to voluntary work to utilize gamification in healthcare solutions. Thus for instance young men on the brink of social exclusion can be made interested in their health. – This at least has huge possibilities for public health that have direct effect on the sustainability gap. Simultaneously, there are great opportunities for productive business solutions. The big volume has encouraged the enterprise to survey new markets on global scale. – You have to dare to go global right away. It is no use playing in the Finnish district series. – Of course, entering new markets also requires more equity, in other words funding.

Out to play

Sometimes it is enough you get up and go out. The Shadow Cities mobile game by Grey Area turns an entire city into a playing field. The players perform activities and compete against each other in a mobile parallel universe using positioning. The game was launched 2010 and soon broke to the helm of location games. A games critic of the New York Times cited Shadow Cities as the future of mobile games in his article. In 2012 year Shadow Cities won the title of best iOS multi player game at Mmofacts.com. Despite all of this positive publicity and "Fighting fit in three months" attitude, the Greay area didi not succeeded in longer term in the international competition.

Finnish games has taken the share of the global digital market. For example, the northern county like Kajaani and a one-man enterprise may become a significant employer when the enterprise receives right kind of support at a correct time.- Finnish enterprises are clearly attractive in Silicon Valley, where networking is crucial and diversity is an essential resource of the networks.

Digital business utilizes and distributes user-oriented, open and industry boundary breaking best practices.- The games business has a great deal to contribute for instance to healthcare. The youngsters are happy to spend time with the games. The health services could also be served like a game to make it interesting. Healthcare solutions in general could benefit from gamification.

Government invests strongly in growth enterprises

The majority of funding for the growth of young innovative start ups flows to the software and digital businesses today.

- At best, the born-global start-ups are scaling their businesses directly into the international market with the help of domestic and foreign private equity investors. Success stories funded are gaming and overall software and mobile businesses.

Success stories play an important role. Hopefully we may read more the success stories during the year.

High standard technical and software competence in Finland

Despite the turbulence in ICT companies, technical competence and software capabilities are of the highest standard in Finland. Finland is ranked 2nd in the Regional European Competitiveness Index. Benefitting from lower labor costs compared to those in other Nordic countries, Finland is home to a dynamic and flourishing start-up scene.

At the turn of the century, together with its subcontractor network, Nokia produced more than 6% of Finland's GDP. Over the past six years however, Nokia has cut some 10,000 jobs nationally and the eco-system around Nokia and Nokia Siemens Networks is estimated to have lost 15,000 to 20,000 jobs. Impressively, approximately 60% of those who left Nokia in the early stages of reorganization are self-employed today. Additionally, Nokia's Bridge program and NSN's spin-off measures, have managed to establish more than 600 start-up companies.

Opportunities through Innovation

According to Wired magazine, 11 of Europe's 100 hottest start-ups are located in the greater Helsinki area. "What we see today is a shift— from mass production to mass innovation. There are hundreds of highly experienced ICT professionals readily available for new opportunities." According to Dr. Tukiainen, from an entrepreneurial perspective, these experienced professionals have the capacity to develop entire product ecosystems in both hardware and software. "Start-ups are armed with extremely competent staff, capable of creating products and services from scratch, continuing to specification, standardization, all the way to production ramp-up," Dr. Tukiainen explains.

Through various programmes and incentives, government agencies such as TEKES and the Ministry of Labor are supporting start-ups both financially and through expert services. For example, in 2011 TEKES funded small and medium-sized enterprises operating in software by 90 million euro and gaming industry by nearly 9 million euro. "Public and private sectors are working together in new ways, to help and fund the ICT start-ups."

By 2016, there will be three billion Internet users worldwide, almost half of the world's population. This is a great national and international opportunity for the Finnish ICT cluster. "We welcome international partners to Finland to take advantage of our proven capabilities. As an example, gaming, mobile applications and digital services have massive potential. New applications and social media continue to boom, making our lives easier and enabling us to live and work with a new level of mobility and freedom," Dr. Tukiainen concludes.

About the Authors

Dr. Taina Tukiainen is a reseacher at Aalto University and Hanken. Previously Taina Tukiainen has worked over 20 years in industry, the latest heading the Digital Business Cluster in Finland and 10 years at Nokia corporation as a senior manager. She has worked also almost ten years as a researcher. She has M.Sc.(Eng), MBA and D.Sc.(Tech.) degree from Aalto. Her research interests are innovations, strategy, ventures, start-ups and entrepreneurship. She does research in international collaboration between universities and industry.

Co-Creating Environmental Services Based on Pollution Citizen Sensing

Brigitte Trousse, Inria Sophia Antipolis - Méditerrannée, France,
Marc Pallot, University of Nottingham Business School, United Kingdom,
Caroline Tiffon, Inria Sophia Antipolis - Méditerrannée, France

Abstract

This paper describes an Open Innovation case study within the European project ELLIOT - Experiential Living Lab for Internet of Things (IoT). In this context, our lab aimed at co-creating green services with a set of stakeholders on air quality and noise measurement on Nice Côte d'Azur (NCA) territory via citizen sensing. Our objectives dedicated to Transport and Health scenarios are:

- Raising public awareness by involving citizens in collecting environmental data and creating a community of empowered citizens;
- Providing solutions that can reduce the environmental impact;
- Alerting the community in case of exceeding the thresholds recommended by the EU.

After introducing the context and the problem, we will first present the main related concepts and works before starting the ELLIOT project. Then, we present our approach for co-creating with citizen environmental IoT-based services, which is based on an eXperiential Design (XD) process, a new Ideation methodology dedicated to IoT and finally our User eXperience (UX) model and measurement methodology related to MyGreenServices portal we implemented. Before concluding about MyGreenServices in order to make it sustainable on the chosen Territory, we describe the main outcomes of this pilot, both issued from the XD process as well as the UX measurement.

Keywords

Citizen Sensing, User Experience, Experiential Design Process, Co-creation, Service Design, Internet of Things (IoT), Living Lab, Smart Cities, Green Services, Environment, Air Quality

Introduction

This paper describes an Open innovation case study managed by the AxIS team from Inria (http://www-sop.inria.fr/axis/) within the ICT Usage Lab (labelled by ENoLL in 2006 and located in the South-East of France) applied to the co-creation of IoT-based green services (in our green use case, air quality and/or noise) within the European FP7 ICT project named ELLIOT - Experiential Living Lab for Internet of Things (www.elliot2project.eu).

Context

Environmental issue is emerging as central in the coming years. The future of our cities, in Europe and around the world, are inevitably dependent on the way we will be able to reconcile economic, social and environmental sustainability.

Concerning environmental purposes, the strategy of Nice is supported by the "Eco-Cité" label given to 13 sites in France by the French Government to new friendly urban planning "Eco-Cité" of the future. The "Eco-Cité Nice Côte d'Azur (NCA)" project is a first step inserted into a larger project called "Eco-Vallée". Eco-Vallée is a "National Interest Operation" that covers around 10,000 ha. It is designed to become a laboratory for sustainable development. The innovation engine of the agglomeration can create a leverage effect on the entire territory. Main issues of this project are: High tech experiments, Well-being, Eco-buildings, Sustainable mobility, Energy management and Natural risks. The ambition of NCA is becoming eco-reference area in terms of sustainable urban development.

Problem

In this context, the French Institute for Research in Computer Science and Automation (Inria), as founding member of ICT Usage Lab, with the support of the French think-tank Fing and SME VULOG aimed at co-creating "green" services, i.e. IoT based services for air quality and noise measurement within the NCA territory of the Riviera Coast. NCA area is viewed as a lab/platform ecosystem for co-creating, exploring, prototyping and evaluating sustainable applications in partnership with citizens, education and research institutions as well as businesses. Let us remind the importance of the environment field in Nice area. Indeed, the City of Nice was one of 24 cities around the world to be awarded by IBM in the frame of "Smarter City Challenge" grant in 2011. This challenge aimed to contribute to the improvement of a sustainable growth. For more information about the assets of Nice area, see (Schaffers & al., 2011; FIREBALL 2012).

In the European ELLIOT project (Sept 2010 – June 2013), Inria for the living lab ICT Usage Lab coordinated the Green Services use case, motivated by the importance of this field in Nice. Our major goals were the following:

- Raising public awareness by involving them in the collection of environmental data and create a community of empowered citizens;
- Involving citizen and all stakeholders in the co-creation of green services based on IoT air quality and noise sensors;
- Focusing on the impact of environmental data on citizen behaviours for transportation and health/wellbeing routines.

Related concepts

This section presents the main relevant concepts or studies related to "designing user experience with living labs", to Service Design for IoT-based services and for Green Services, before deploying our Green Services pilot.

Designing User Experience within Living Labs

According to William Mitchell, professor at the MediaLab and School of Architecture and city planning at MIT, a Living Lab (LL) represents a user-centric research methodology for sensing, prototyping, validating and refining complex solutions in multiple and evolving real life contexts. He identified several noticeable impacts and benefits, such as the integration of the users into the development process for ensuring highly reliable market evaluation; the reduction of technology and business risks, as well as decreasing investment needs for SME, micro-organizations and start-ups, since they can share resources without mobilizing so much venture capital; and share access to a broader base of ideas, especially for large companies.

Since 2006, the LL approach was gradually applied within EU projects for involving all stakeholders, especially users and also policy-makers, at the earlier stage of R&D. A LL is often defined as a user-centred open innovation ecosystem integrating research and innovation within a Public-Private-People partnership through an iterative design process. Curley & Salmelin (2013) argue that Living-Labs engage users in open regional innovation ecosystems representing a quadruple helix innovation mode beyond traditional technology driven testbeds.

A LL combines the UX quality in co-creating, exploring and experimenting with users a product/service with the capacity to capture previous design experiences (Arts & Marzano, 2003). It means that within LLs, UX covers the entire design process. For more definitions and concepts related to designing UX with living labs, see (Pallot, 2009; Pallot & Pawar, 2012).

Experiential Design (XD) Process

According to Erkinheimo-Mennander and Arjanne (2011), innovation failure has reached the rate of 86% due to the lack of user adoption and understanding of users' preferences.

While traditional industrial design process focuses mainly on product conformance with needs and requirements specified by developers, it rarely involves users, except in some cases as observed subjects, and simply ignores users' potential contribution in the value co-creation.

In contrast, the experiential design (XD) process, formalised during the ELLIOT project, shifts the priority from designing product features towards co-creating value with users in order to ensure a higher rate of service adoption. However, it requires all stakeholders, including users, to be engaged along the design process (see Take in Figure 1) for co-creating, exploring, experimenting and evaluating product/service scenarios (Pallot, 2012). These four activities are intended to better support the identification of value expected by users (e.g. usability, reliability, affordability, social interaction, empathy, fun) and supporting features that would convince a large community of users to adopt an innovative IoT-based product/service.

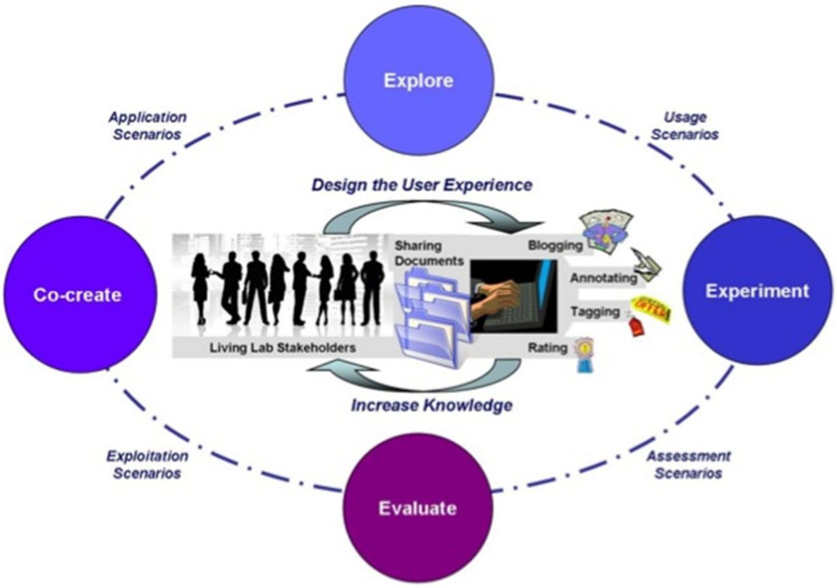

Figure 1. Iterative Design Process adapted from (Pallot 2009).

The XD process requires focusing on designing for value that is iteratively validated by experimentation and UX evaluation until it reaches the targeted score. Hence, exploring patterns of usage, capturing emerging people behaviour and evaluating the impact on service adoption become a corner stone in the design iterations and refinements. The intended goal is to raise the level of product/service adoption by a large community of users.

According to Pallot and colleagues (2013), the XD process is an iterative process (see Figure 2) that links together the four activities to be carried out whatever is the innovative scenario to be designed. It consists to: co-create ideas of new concepts, artefacts and/or innovative scenarios as sessions of collective creativity involving all concerned stakeholders and especially users; explore alternative scenarios in setting the scene through the use of different immersive techniques within a live environment; experiment alternative scenarios in prototyping concrete application/services through the use of a technological platform within a real-life environment; evaluate alternative scenarios on the basis of metrics for measuring both the Quality of Service and the Quality of Experience that would allow assessing the degree of adoption by users.

The XD process is correlated to Mitchell's Living Lab user-centric process composed of research methodologies for sensing, prototyping, validating and refining complex solutions in multiple and evolving real life contexts (see Figure 2). In our view, "Sensing" leads to consider simultaneously the context, users, and the existing and emerging technologies (e.g. sensors, actuators) for co-creating and exploring innovative scenarios. "Prototyping" means to concretise alternatives that allow experimenting them with users in real life situations. "Validating" is the outcome of the evaluation of the experiments' results. Finally "Refining" leads to the identification and discussion with all stakeholders of potential refinements in order to prepare the next iteration until it reaches the proper level of user adoption. The main goal of the iterative XD process is to support the design for value that is continuously evaluated through the UX life cycle (Roto et al., 2011).

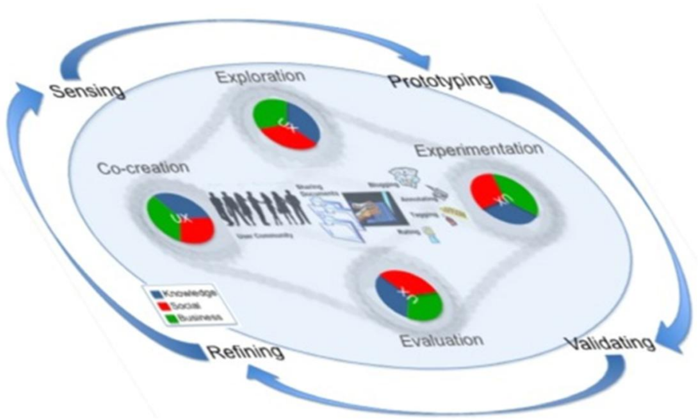

Figure 2. The Interactive Nature of the Experimental Design Process

A LL combines the UX quality in co-creating, exploring and experimenting with users a product/service with the capacity to capture previous design experiences (Aarts & Marzano, 2003). It means that within LLs, UX covers the entire design process. A recent survey among ENoLL Livings Labs (Pallot, Krawczyk & Kivilehto, 2013) reveals that User Co-creation and User Experience constitute the top two LL practices for engaging users in the R&D process.

User Experience and the UX Holistic Model

There is a considerable amount of publications dedicated to UX (Alben, 1996; Norman, 1999; Hassenzahl et al., 2000; Rubinoff 2004: Schrepp et al., 2006; Kankainen, 2002). There are many definitions of UX. For more details, see Scapin and al. (2012) and Pallot and Pawar (2012), as well as the standardised one from ISO 9241-210 (2009): "User Experience is a person's perceptions and responses that result from the use or anticipated use of a product, system or service". The ISO description presents UX as "all users' emotions, beliefs, preferences, perceptions, physical and psychological responses, behaviours and accomplishments that occur before, during and after the use of product, system or service". It also mentions that the type of product/system/service, user profile and the context of use are factors that influence UX. More recently, Scapin et al (2012) reported on the positive side that UX has become very popular but on the negative side UX has several meanings, with a varying and complex coverage of topics and issues, and according to Komulainen (2008) is very subjective and versatile by nature. Roto and his colleagues (Roto, 2008; Roto and al, 2011) introduce the notion of episodic, momentary and cumulative UX (as shown in Figure 8) related to the time spans of UX measures.

Based on a literature review and study on UX types, concepts, elements and their properties carried out during the ELLIOT project, a holistic model (Pallot & Pawar, 2012) has been created in order to provide a global UX model that could be instantiated whatever is the use case domain. After instantiations and experimentations in various use cases within the ELLIOT project, the refined version of the UX model includes 10 experience types, 18 elements and 40 properties as shown in Figure 3. This model was used for analysing the user experience of MyGreenServices (see Take in Table 4.)

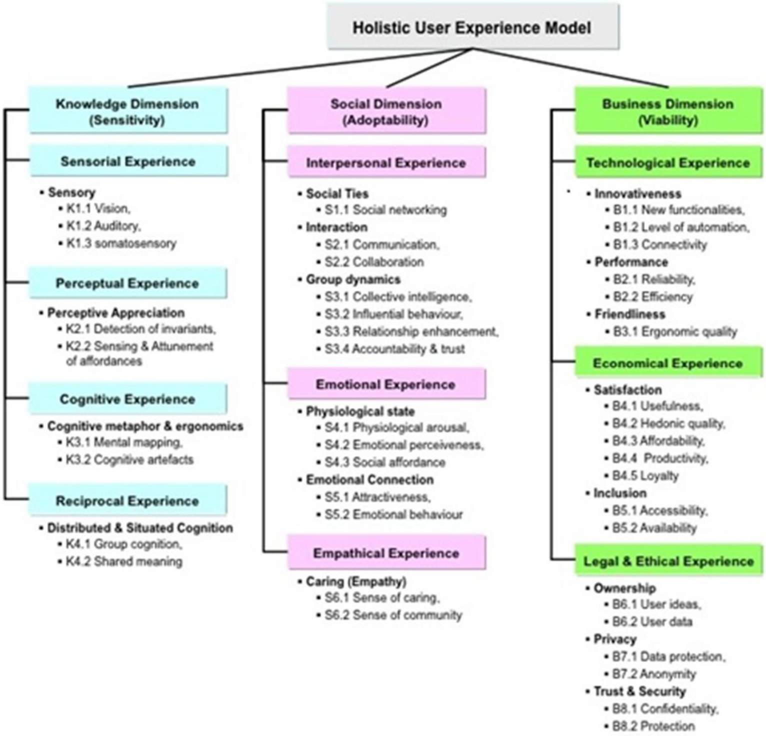

Figure 3. A Holistic View of User Experience Extracted from (Pallot & Pawar, 2012).

According to the three perspectives (Bifulco and Santoro, 2005), three categories of experience types were identified (Pallot & Pawar, 2012), namely: Knowledge (sensorial, perceptual, cognitive and reciprocal aspects), Social (interpersonal, empathical and emotional aspects), and Business (technological, economical, legal and ethical aspects). The names given to all experience types are voluntarily based on convenience for practical simplicity and understanding rather than deep scientific foundation.

IoT-based Service Design

Over the past decade, two well-known types of service design techniques for getting insight people' lives have become popular and efficient for co-creation with users: the generative techniques (say and make) and the bodystorming ones (do). Let us describe briefly these two types of techniques, issued from (Negri and al., 2012).

Cultural probes (or design probes) is a technique for idea generation, inspiration, values and dreams in a design process. It was initially developed by Gaver and colleagues (1999) and serves as a means of gathering inspirational data from people in a wide variety of projects. The idea of using probes or artefacts in the co-creation process is that this kind of technique enhances the communication between designers and users as well as it offers opportunities for further exploration. Kuznetsov and Paulos (2010) presented a research where various stakeholders (students, parents, homeless) were invited to place environmental sensor probes in the public space and to take pictures of the placement during one week. After the experiment, an interview was organized and the pictures were gathered by the researchers.

Bodystorming is not something new. It is an approach allowing the generation of unexpected ideas that might not be realized by a traditional brainstorming for example (talking or sketching). Bodystorming can be defined as a type of participatory method for demonstrating concepts with a physical approach. Ideas are developed through acting. Thus, unlike brainstorming it is not just a written idea, and is often a technique that is used in the early stages of interactive design. In the service design domain both improvisation (incl. brainstorming) and role-playing have been used for fostering innovation and highlighting user needs since decades as highlighted by Medeler and Magerko (2010). It builds upon the notion of "bodystorming" coined by Simasarian (2003), whereby participants not only project themselves (at a rational and controlled level as they could do while reading a usage scenario) in an given role but do enact as the character they play, therefore live a deeper experiential learning and go through another cognitive process as well as group processes.

For ELLIOT purposes, ICT Usage Lab researchers developed two new Ideation methods (GenIoT and Aloha! (Negri and al., 2012) that have been tested in R&D context before being applied during the co-creation workshops (see Section Our Approach).

Citizen Sensing & Green Services

According to our goal of involving users in the co-creation and exploration steps of the XD process for green services, some previous work related to smart citizen environmental sensors and citizen sensing for environmental purposes were identified before starting the ELLIOT project in 2010 and reported below. Our objective is to build awareness through the act of monitoring and also to develop a user community.

Let us start with noise that is a serious problem in many cities and the research project NoiseTube started in 2008 at the Sony Computer Science Laboratory in Paris in collaboration with Vrije Universiteit Brussel (VUB). NoiseTube (www.noisetube.net) was created with the purpose of turning smartphones into mobile noise level meters. The application allows citizen to participate in the collective noise mapping of their city. NoiseTube has three features: measure noise, localize it and tag it. Tags include the level of annoyance and the source of sound, such as an airplane. The collected data is wirelessly sent to the NoiseTube server in real time. Once the data has been uploaded to NoiseTube's Web site, users can check their sound trajectory on Google Maps.

Concerning air quality and citizen sensing, let us cite three projects for illustrations. First Pre-emptive Media's AIR project (www.pm-air.net) which is a public, social experiment launched in 2006 and inviting people to use air monitoring devices in their urban environment, to collect data and see pollutant levels in their current locations and simultaneously view measurements from the other devices in the network. Secondly in 2009 the French think-tank Fing with its partners experimented in Paris a green watch with its City pulse platform. The Green Watch project was based on similar experiences carried out in London, New York and San Francisco: the watch communicated its measurement's data via the mobile phone of the user to a common platform either in real time or at night for synchronisation. Thirdly Patchube has launched a device called "the air quality egg" (cf. http://airqualityegg.wikispaces.com/AirQualityEgg) sensing nitrogen dioxide and carbon monoxide, which has built a community of interest around air quality and the construction of independent collective infrastructures. The Air Quality Egg community was born out of groups from the Internet of Things Meetups in New York City and Amsterdam. The Egg base station has the ability to convey information through a coloured light and also has a button for user feedback. The outdoor air quality data is sent in real-time to Patchube, an open data service, which both stores and provides free access to the data.

Various smart pollution devices have been proposed. Netatmo (www.netatmo.com) proposes smart connected weather and CO2 citizen sensors and services on smartphones/tablets (with weather maps on the world). Azimut Monitoring (www.azimut-monitoring.com) specialist in air quality/noise urban monitoring proposes also smart citizen/city sensors (outdoor and indoor) and services. Students from Carnegie Mellon University have proposed low-cost giant air quality balloons (http://www.instructables.com/id/Air-quality-balloons/) which react to surrounding air quality: inside each balloon there are a tri-colored LED and an air quality sensor turning green, yellow or red based on low, average or high values.

Finally we can cite a recent European Research (ERC 2013-2017) project called "Citizen Sense" (www.citizensense.net), based on a crowdsourcing application which is a crowdsourcing which proposes some cases under progress, such as urban sensing and air walk.

Even if some of these green services are based on citizen sensing and on manufacturing low cost sensors by citizens with a Do-It-Yourself approach, no work has been found at the beginning of the ELLIOT project related to the UX design and measurement of green IoT-based services within living labs.

Our Approach for Co-creating Green Services

In this section, we first present a) the XD process we have been followed for co-creating green services with citizen, b) the Ideation methodology we adopted for co-creating IoT-based green services and finally c) the UX model elaborated based on the holistic UX model and the methodology used for measuring UX of MyGreenServices and finally the citizen environmental data platform we implemented.

The XD Process

The XD process in the Green Services use case followed the four steps as presented in Figure 1 and illustrated in Figure 4 for our two scenarios conducted in an iterative way. We used a participative approach from the ideation to the test. Indicators of the Knowledge, Social and Business dimensions are computed for UX analysis and, more generally, for the service refinement.

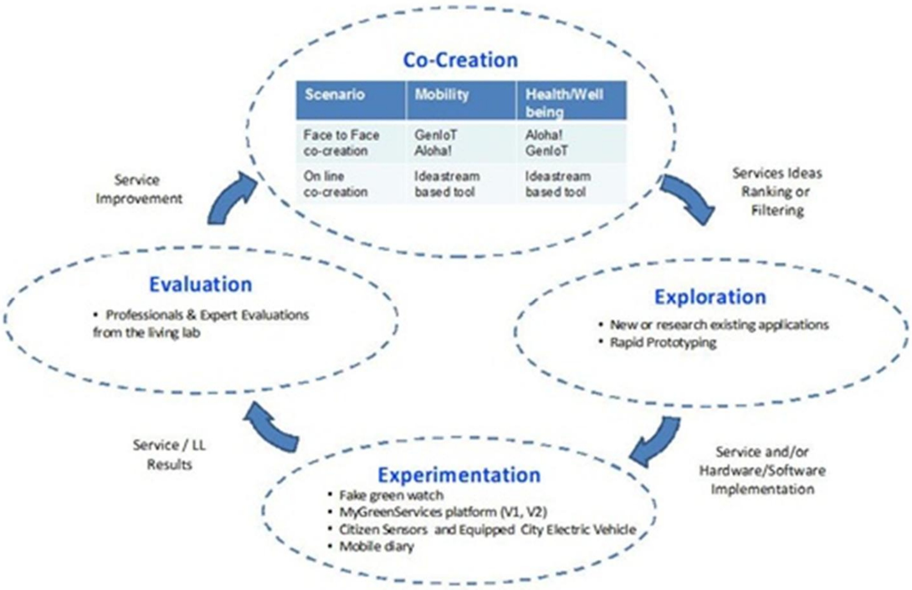

Figure 4. Experential Design Process Deployed for Green Services Use Case

Our use case is grounded on an original methodology combining participatory design methods for the whole process (face-to-face and online focus groups), diary studies for IoT experience analysis and a quantitative and qualitative approach for MyGreenServices UX measurement. This process has involved almost 50 active participants in the various workshops or experiments as shown in Table 1:

Table 1. Participants Involved

Co-creation / Exploration			Experimentation/Evaluation			
	Workshops Mobility	Workshops Health	Fake green watch	Experiment 1	Experiment 2	Total
Participants	13	8	6	13 (9 producers)	8 (6 producers)	48

For co-creation/exploration steps, we organised for each scenario (Mobility and Health/Well being) two workshops with the use of an IdeaStream-based tool for sharing ideas between each workshop. For each scenario, we applied our Ideation methodology elaborated within the ELLIOT project and described later.

For the experimentation/evaluation steps, due to important delays in manufacturing the second version of the green watch, we organised a fake green watch diary study with 8 citizens which was very fruitful about their contexts of use and their interests in terms of pollutants. In parallel based on the output of the previous steps, MyGreenServices platform has been developed, tested with citizens and improved via user feedbacks. The aim of the last experiments is to assess the UX and experiential learning related to MyGreeenServices; this includes experience related to the IoT devices, to the measures and services as well as air quality awareness and behaviour changes monitoring.

Two experiments have been carried out in February and in June 2013, with the aim to test the MyGreenServices platform by two types of user profiles (data consumers and data producers) and to measure UX. Data from pollution sensors were recovered and fuelled in the maps of MyGreenServices platform developed in the project. During the experiments participants were asked to fulfil various questionnaires in a longitudinal study to evaluate their awareness of air quality, their experience with the services provided by the platform (alerts, forum) and the user change behaviour on air quality. The involvement of users during the experiments was constant and the overall level of satisfaction was high.

Proposition of an Ideation Methodology

For supporting the co-creation/exploration steps, ICT Usage lab researchers proposed an Ideation methodology (Negri and al, 2012) elaborated during the ELLIOT project: it relies on the coupling of two Ideation methods (GenIoT, Aloha!) and the use of an open source collaborative idea management tool (IdeaStream from http://www.gi2mo.org/). This methodology has been applied for two scenarios Mobility and Health & Well Being, during workshops where participants were invited to imagine a green service.

With GenIoT, participants were invited to use probes during two weeks and think about the sensors position and they would therefore have access to the types of measures. They were supposed to place the probes and take a picture (see Figure 5). The second method called Aloha! is a role play with three steps (casting, meeting, playing), where participants after selecting a role (persona or object) met the others, built a scenario and played it. After an initial surprise effect caused by the playful aspect of the Aloha! method, participants tend to choose cards representing persona rather than those with intelligent objects (see Figure 6).

Figure 5. GenIoT Method – Fake Sensors with Indications of Wished Actions

Figure 6. AloHa! – Designers Enacting IoT Green Service Scenarios during the Health Workshop

In support, there was a customized IdeaStream-based platform (with gamification) dedicated to sharing ideas. The photos from GenIoT and the scenarios from Aloha! were put online in order to allow exchanges between the workshops and enhance the development of the ideas (see Figure 7).

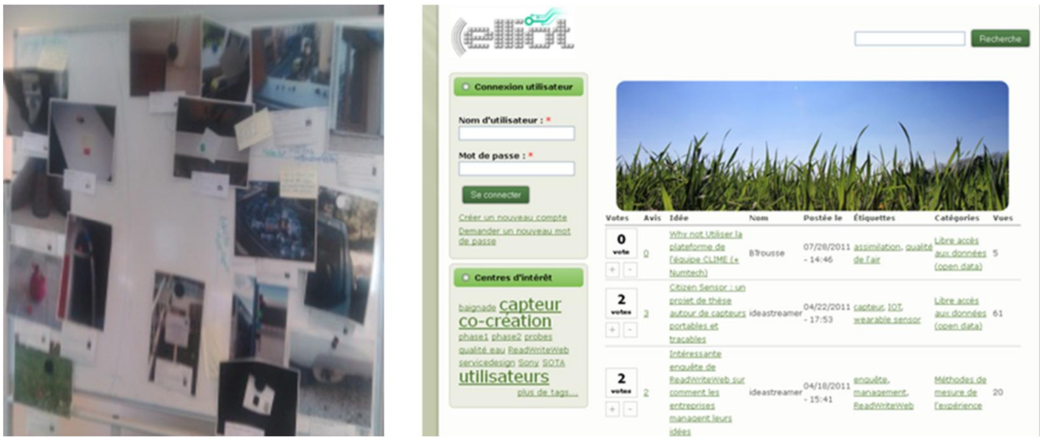

Figure 7. Sharing Ideas with a Gamified Ideastream-based Tool

The most reported benefit of our GenIoT method was that it increased the awareness about air quality and noise, in a permanent manner. It is very relevant since one of the aims of the use case was behaviour change and so on awareness about environmental issue. Some questions were raised permanently such as: "how can I put a sensor there?, how can I measure that?" In relation to this, there is the social aspect of the method. Indeed, their families or strangers asked participants about the signification of the cubes. Therefore, the awareness from individual became collective.

Aloha! is rooted in the bodystorming and its originality is that participants have the possibility to play not only persona but intelligent objects too. GenIoT allows participants to explore the say and make dimensions and its originality lies in the use of a diary and the collaborative platform dedicated to ideas sharing (a customized IdeaStream based platform). Finally the novelty on the approach developed here is in coupling two methods, maximizing with multiple supports and experiences the creativity of the group, but also in approaching the Internet of Things along the three experiential dimensions: say, make and do.

Our UX Measurement Methodology

In accordance with the overall objective of MyGreenServices, our UX measurement methodology focused on the level of awareness/experiential learning raised after usage of MyGreenServices (awareness pollution, awareness of citizen dissemination and change of behaviours), the ease of use and diffusion aspects (as being a tool provided to the citizen).Two objects of the learning were considered: IoT via MyGreenServices portal and Air quality. We used differential between a pre-profile and post-profile.

Our UX approach in the context of ELLIOT project (see Section 5 in Tiemann and al. 2013) relies on the following six steps:

Step 1: Select an UX model: in our context we instantiated the UX holistic model (see Figure 3) for our service i.e. we selected potential UX elements and properties. To address our overall objective according to the K, S and B dimensions, twelve UX properties have been selected to describe the user experience (see the first three columns of Table 4):

- **K** dimension: our main goals were to increase awareness on IoT paradigm and update knowledge on the impact of air quality in daily lives. Specifically the "cognitive" elements have been selected i.e. learning and understanding about behaviour change: Cognitive Artefacts and Sensing Affordances ;
- **S** dimension: our main goals were to foster user involvement in air quality measurement and encouraging information sharing. Specifically the "reciprocal" elements for the usage of the IoT based system as a persuasive and dissemination tool have been selected i.e. creating an interest about air quality and pollution in the community of users (collective intelligence);
- **B** dimension: our aim was mainly to provide robust, easy-to-use and engaging green services and to change citizen behaviour towards a more sustainable lifestyle. B elements for the technological functionality and ease of use have been selected, i.e. the solution should be user friendly (Ergonomic Quality) and providing reliable data (Reliability) taking care of personal data (Data protection).

Step 2: Clarify the types of UX and the time spans you choose for measuring UX properties and elements; indeed UX measures could either be cumulative, episodic or momentary as shown in Take in Figure 8.

Table 2. UX types and targets assessed via online questionnaires

	MyGreenServices	Alert	Forum	Maps/ Measures
Momentary UX				{Q3}
Episodic UX	Q1.1, Q1.2	Q1.2	Q2	Q2
Cumulative UX	Q1.2, Q4, interview	Q1.2, interview	interview	interview

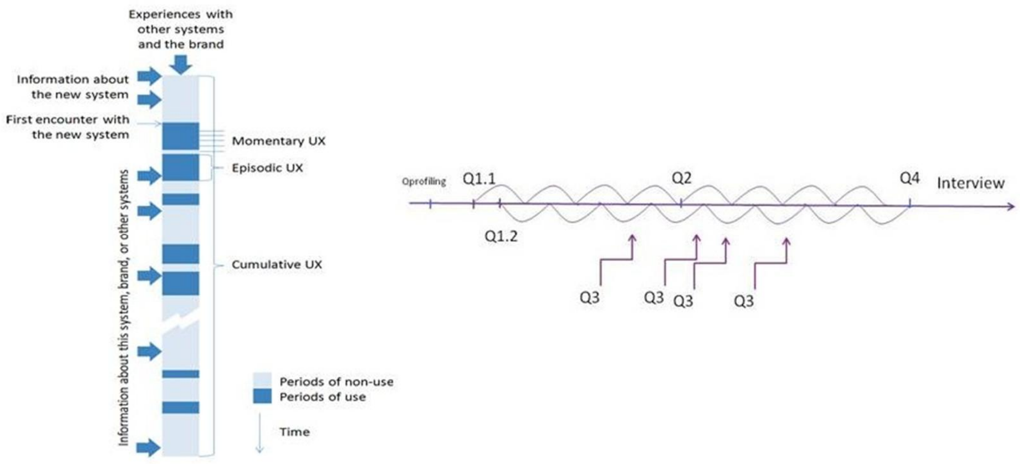

Figure 8. Time Spans: Types of UX (left) from (Roto et al 2011) – (right) from MyGreenServices

Step 3: Define relevant questions and/or data for indicator computation. Heterogeneous data have been selected:

- Five questionnaires have been used. User experience and behaviour changes were assessed via one user profile questionnaire and 4 types of online questionnaires:
  - The User Profiling questionnaire (Qprofiling) used to recruit our participants for the co-creation workshops has been used also for the experiments. It includes 65 questions about several themes: Lifestyle; Participants and Sustainable Development; Participants and ICT's; Participants and respiratory diseases; Green Services; Personal details.
  - One online contextual questionnaire (Q3) triggered at most twice a day and sent to the participant by SMS for an immediate answer. Such a questionnaire aims at gathering data on the participant experience of the air pollution.
  - Two online recurrent questionnaires (Q1.1 and Q1.2), triggered every 4 days in order to measure change in behaviour and opinion;
  - Two online one shot cumulative questionnaires at mid (Q2) and end (Q4) of the experiment (in order to gather the holistic UX and prepare the interview. Attitude changes were also assessed by measuring the pre/post experimentation delta;
- Logs: Logs of MyGreenServices, Logs from gamified forum, Contents of the forum, IoT data (more than 4 millions of measures);
- One individual Interview in order to debrief and qualify the data held at the end of the experimentation.

We summarize in Table 3 the various types of data used for each property.

Table 3. Types of Collected Data for our 12 UX Properties

Direct questions		Indirect questions	
Without log	With log	Without log	With log
S2.1	S1.1	K2.2	K3.2
B2.1	B6.	B4.2	S5.1
		B7.1	B3.1
			B4.1
			B4.5

To illustrate indicator computation, we choose Attractiveness (S5.1): to compute it, we use the user answers to two indirect questions (q7 and q9) from questionnaire Q4 and data from MyGreenServices logs.

- q7: Would you recommend the portal to your friends?
- q9: Have you recommended MyGreenServices to your friends / acquaintances?

Step 4: Define UX indicators and their weighting for each UX properties/elements computation (cf. Table 4) based on selected raw data. Each property of the holistic model was assessed by one or more dedicated questions and/or usage data (logs, data inputs in the forum, etc).

Table 4 reports the mapping between our instantiated UX model for MyGreenServices and the elaborated indicators for the mapping and the data used to compute them.

Step 5: Define the UX metrics for UX indicators and rules linking UX indicators and UX properties and elements. To address K dimension, we used Bloom's taxonomy (Bloom et al., 1973) for supporting us.

Below we illustrate with three examples of such rules for Green Services:

Cognitive artefact (K3.2) is evaluated by merging four questions and portal data log: the capacity of the user to remember the last value seen on the MyGreenServices portal, their perception of behaviour change, the comparison made between data provided by the MGS portal and other sources and the usage of the downloading functionality.

- If % users able to self-assess their environment are < 20% then Cognitive artefact is low;
- If % users able to self-assess their environment is > 20% and <40% then Cognitive artefact is medium;
- If % users able to self-assess their environment are > 40% then Cognitive artefact is high.

Social networking and openness (S1.1) is calculated merging one question and the data log: by measuring the activities i.e. the level of use and merging the usage log, the aim is to determine the utility of the forum for sharing information.

- If % users inactive > α then Social networking and openness is low;
- If % users proactive >= β the Social networking and openness is high;
- Medium for the rest.

Here α = 90% and β = 2% were chosen based on the common rule (http://en.wikipedia.org/wiki/1%25_rule).

Usefulness (B4.1) is calculated by aggregating the analysis of three questions related to *a change of behaviours during and/or after the experiment* in terms of: transportation, aeration, outgoing, sport, aeration or others. This is obtained with one method from FocusLab (2013) by clustering users based on their answers related to their behaviours of the diary study at every two days and analysing change in terms of clusters. Interviews help us to better understand the behaviour change.

- If % users declaring a change of behaviour > 5% then high
- If % users declaring a change of behaviour < 5% and > 1% then medium If % users declaring a change of behaviour < 1% then low

Step 6: Collect and pre-process experimental and log data for UX indicators computation inside the living lab. Pollution context for each participant is computed via advanced data stream mining methods from AxIS software of FocusLab platform (focuslab.inria.fr) as well as its usage of MyGreenServices in order to ponder some values of UX indicators and finally UX measures.

Table 4. Data – UX Indicators Mapping for the Experimentation

	Ref	UX Properties	Input	Indicators with weighting
		Knowledge		
Perceptual	K2.2	Sensing and attunement of affordances	Questionnaires	Air quality knowledge
Cognitive	K3.2	Cognitive artefact	Questionnaire, Log, Interview	Environment evaluation, Change in activity, IoT Data comparison
		Social		
Social Ties	S1.1	Social Networking and openness	Questionnaire, Log	Level of activity, Frequency of connections, Forum statistics
Interaction	S2.1	Communication	Interview	Number of MGS demonstrations
Emotional Connection	S5.1	Attractiveness	Questionnaire, Log	Number of intended recommendations, Number of effective recommendations, Frequency of connections after experiments
		Business		
Performance	B2.1	Reliability	Questionnaire, Log	Perceived data reliability, Frequency of connections
Friendliness	B3.1	Ergonomic quality	Questionnaires, Log	General findability Forum findability, Alert service opinion, Intuitivity of alert service
	B4.1	Usefulness	Questionnaire, Log, Interview	Alert programmation, Change in habits, Alert logs
Satisfaction	B4.2	Hedonic quality	Questionnaires	MGS opinion , Reaction to alert service, Forum opinion
	B4.5	Loyalty	Questionnaires, Log	Intention of use, Frequence of connections (perceived)+ data logs connections and users sessions
Ownership	B6.1	User ideas	Interview, Log	Number of new services, Forum statistics
Privacy	B7.1	Data protection	Questionnaire	Data protection (perceived)

The originality of our UX measurement methodology is based on the use of heterogeneous data, on the identification of relevant indicators as aggregated/computed variables based on advanced data mining methods (FocusLab, 2013) and finally the definition of UX rules linking UX properties and UX indicators.

Results

In this section we describe the three main results obtained during our Green Services use case.

Exploration – Co-creation

In order to introduce the process, several presentations were done concerning either IoT and noise/pollution or IoT and health/well being solutions. Then a few exploratory sessions were organized (Air Paca, Green Watch v1, Nice Air mock-up) using think aloud and verbal analysis.

In order to improve the analysis all the workshops were video recorded allowing the LL researchers to analyse the workshops using both video transcripts (verbal analysis and restitution of participants' ideas) and video analysis (body language).

The attitude of participants towards the two Ideation methods was globally positive even if unexpected – especially in the case of well-being professionals. For more details on the used methods, see (Negri and al., 2012).

After a run of both Aloha! and GenIoT methods the ideas were listed and participants have to vote for their favourite one, in order to work on the development of a usage scenario. At the end of the mobility workshop a list of four ideas of green services based on IoT emerged, but the elaboration of the usage scenario fails because of a lack of collective implication. However, in the health workshop only two ideas of green services based on IoT have been developed, but in the last workshop participants went further in the co-creation process. Indeed, the transcripts of de first workshop allowed the LL researchers to establish a usage scenario using a dedicated tool as illustrated in the Figure 9 below.

Figure 9. Part of the Usage Scenario in Health (people with respiratory problems).

In the last meeting, after reading the usage scenario, participants went further prototyping an intelligent object as shown in the Take in Figure 10.

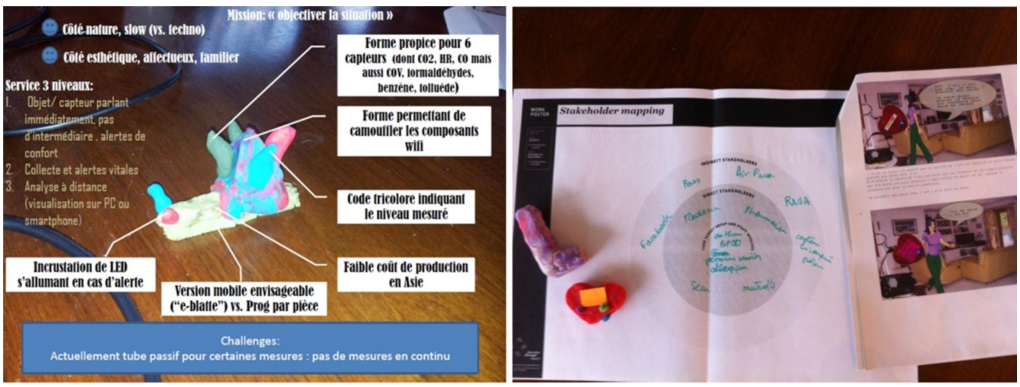

Figure 10. Face-to-face Workshop Productions (smart indoor air quality object, smart key holder)

MyGreenServices, a Pollution Citizen Data Platform

ICT Usage Lab researchers based on the citizen/professionals productions during the co-creation/exploration steps implemented an environmental data platform called MyGreenServices (MGS) and based on citizen sensing in order to raise public awareness and to create a community of empowered citizens. Let us note that in ELLIOT project proposal, our use case should involve outdoor environmental sensors (ozone, nitrogen dioxide, micro-particles) and two scenarios mobility and health/well being. So, even if within the different workshops, monitoring indoor air quality seems to be more for participants than outdoor air quality and also other pollutants such as pollen in our Nice region seems to be requested, we maintain, due to some ELLIOT constraints (proposal content, budget), to address outdoor air quality monitoring by citizen sensing.

MyGreenServices (mygreenservices.inria.fr) offers various green services such as the visualization of environmental data collected by citizen, the alert services, the ability to download data, the forum for sharing ideas and best practices in terms of eco-responsible behaviours. A pollution-alert service has been created considering two points of view: the first one consists of localising a person and indicating via email or text message the passage through a polluted area. The second one allows the user to define an area to follow and the user will be advised of pollution alerts for the area by email or text message. Privacy protection inside MyGreenServices has been taken into account with various features such as user authentication with CAPTCHA and email validations, SSL certificate, two separate data bases for sensors and for users and portal logs, and a loan agreement for sensors.

The IoT set up includes both citizen mobile & fixed sensors and one equipped MIA city electric vehicle related to pollution measures. The collected IoT data and green services are accessible to citizen/professionals on a community open data portal (see Figure 12) called MyGreenServices (mygreenservices.inria.fr with free registration). Two types of users are managed: data consumers and data providers (those who got an environmental sensor for data collection).

Two types of citizen sensors (see Figure 11) are used:

- Mobile sensor with user documentation and information on the pollutants (ozone O3, nitrogen dioxide NO2, noise) could be used on bikes, cars, or weighted by pedestrians;
- Fixed sensors with user documentation and information on the pollutants (dust or micro-particles PM10): these sensors should be used on balconies being well exposed to the sun.

Figure 11. Fixed and Mobile Citizen Air Quality/ Noise Sensors

Figure 12. MyGreenServices “Citizen Measures” Page.

A first added value of Citizen Production is the user feedback on the first version of MyGreenServices and on each user guide elaborated of our three types of citizen sensors. User feedback helped us to improve the service and to create new services in the second version: more access to all sensors, pollution synthesis by quarter/time-period, improvement of mobile sensors tracks inside MyGreenServices maps, etc. The second experiment confirms UX results obtained during the first experiment and most of UX indicators values are better with the second version of MyGreenServices improved with user feedback (see Figure 15).

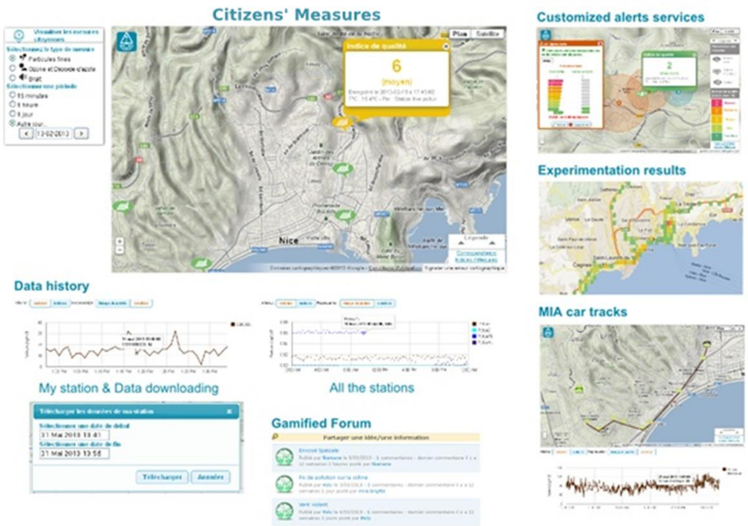

Figure 13. MyGreenServices Dashboard

Producers had an IoT device (fixed for PM10: Pollux – and AxISBox (based on Arduino) in the second experimentation – or mobile for O3 and NO2: Azimut) and their task was to charge the device regularly to ensure proper operation of the device and fill out questionnaires as part of a longitudinal study. Consumers should consult data on MyGreenServices portal while responding to questionnaires.

A second added value of Citizen Production is the generation of a pollution database from mobile and fixed IoT sensors with around 4 million pollution measures through the ICT Usage Lab, and also other valuable user contributions (usage scenarios and ideas during the workshops, posts on the forum).

Figure 14. MyGreenServices “Gamified forum” Page

User Experience

The two experiments related to MyGreenServices indicated very similar good qualitative results in terms of UX properties (high and medium) with better quantitative results for the second experiment (as shown in Figure 15) mainly due to the improvement of MyGreenServices (v2) based on user feedback and on an improved community management.

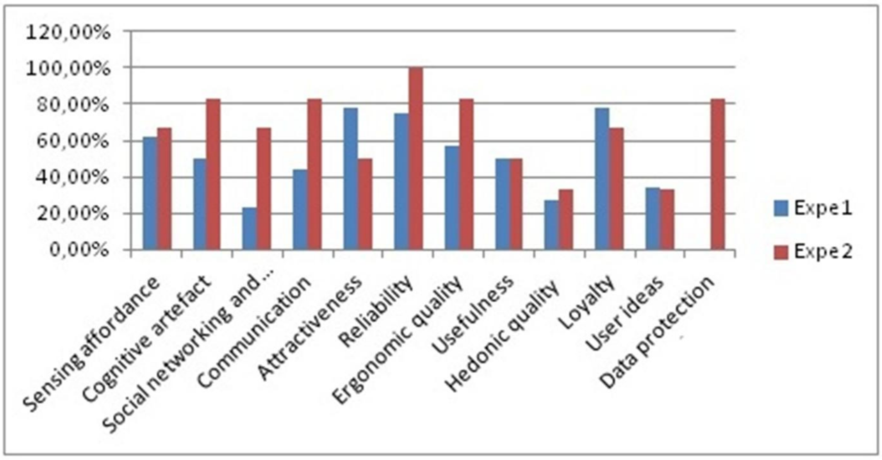

Figure 15. Quantitative Values of UX Properties.

The percentage of users finding MyGreenServices portal and its components intuitive increased between the two versions. Concerning Reliability, participants of the second experiment are more confident in the measures provided by MyGreenServices than those in the first experiment, due to an improvement of the exchange quality between participants and experts. Regarding Social Networking and Openness, the percentage of users having activities of posting ideas, comments etc. in the forum (pro-active user) increased in an important way.

Using MyGreenServices and Citizen sensors, 62,5% of users declared a change of perception in the awareness against air quality (cf. K2.2) and 44% of users declared a modification in their activities during the experiment (cf. K3.2): for example two participants chose a less polluted place for their jogging, one reduced the indoor heat temperature when loading the sensor at their home and another participant chose a common urban transport in case of high pollution.

Related to Business dimension, the second version of MyGreenServices based on user feedback has been perceived as a real improvement compared to the first one (more data access, more curves, IoT data synthesis, a better community management, etc.). For more details on UX related to MyGreenServices, see Section 5 in the Elliot deliverable of Tiemann and colleagues (2013).

Discussion – Conclusions

Primarily Green Services Use Case deployed in the context of the ELLIOT European Research project on the Riviera Coast (France) was a very fruitful experience for our LL in deploying an XD process related to green IoT-based services. The main lessons concern: the positive impact of engaging citizens in all steps of the XD process and in the interest community creation; the impact for people of sensing environmental data on their engagement with space; the improvement of the first version of MyGreenServices and of IoT guides based on user feedbacks; and the usefulness of measuring UX of such services in order to better understand and evaluate their impact related to citizen awareness and behaviour change.

Secondly, concerning implications on methodological research, we have experimented an original Ideation methodology for IoT based services (Negri and al., 2012), elaborated during the ELLIOT project and coupling two ideation methods and a gamified idea generation tool. Gamification was also very efficient for encouraging citizens to participate during our two experiments of MyGreenServices. The improvement of the community management during the last experiment of MyGreenServices had very positive impacts. The diary study was very effective and efficient related to the "fake green watch" experiment and also for the two MyGreenServices experiments. More lessons were also learned from internal tests aiming at installing the IoT devices in a "live setting". Such tests also enhanced the list of requirements and warnings to be presented to the participants volunteering for hosting IoT devices (battery charge for instance requires participants to really take care of the IoT device, but also protection of the sensor was an issue).

The UX holistic model used for elaborating our UX model was useful as a first step but Indicators and metrics for the measurement of each selected property of the different types of experience are not obvious to identify and often quite demanding. Writing rules linking UX indicators and UX properties has appeared as a difficult task requiring some referential thresholds that are not always available or consensual in the scientific community. We have started to elaborate an UX measurement methodology in order to support UX model instantiation and measurement dedicated to various types of UX or service goals in the context of IoT-based services. More interdisciplinary research on UX is needed involving Human and Social Sciences and ICT. Exploiting user contexts based on IoT data stream analysis as we have started in ELLIOT project seems also very promising in order to improve the UX understanding and to report it to users. Designing persuasive interfaces in order to increase pollution awareness and provoke eco-responsible behaviour changes is also very challenging at the urban level. Finally, in addition to our UX approach and the XD process followed in the design of MyGreenServices, more research should be done to articulate UX and Agile approaches.

Thirdly, to conclude on UX of MyGreenServices, after the two 16-days experiments, participants have increased their awareness on air quality. This can be considered as a first step in the behaviour changing process. We also noted some behaviour changes based on using MyGreenServices but more data are required with a statistical point of view. At the end, a community of around 50 active contributors (citizen/professionals, co-creators/data producers) has been created and they exchange on these questions in our forum. The MyGreenServices pilot can be seen as a successful pre-test. Our lab is now studying how to pursue this case study with more experiments involving more users with a smartphone version of MyGreenServices that is already specified. More citizen sensors are required in order to cover in a relevant way a large territory such as the city of Nice; and to better promote some existing interesting functionalities of MyGreenServices such as the customised alert service by email or sms. More research and experiments are required where new economical models should be elaborated involving the territory's stakeholders and citizens based on the value of their productions.

Finally, current and future work concern the study of various ways to exploit the numerous assets for our lab issued from the ELLIOT project (sensor data collection, citizens productions, user experience data, know-how, etc.) and to manage other experiments on the economical aspects. So we are pursuing our interaction with NCA viewed as an ecosystem to co-create sustainable applications/social innovations in partnership with citizens, stakeholders, research institutions and public agencies such as Air PACA.

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Acknowledgements
This work was carried out in the context of the ELLIOT EU ICT Project that was partly funded by the European Commission. Authors wish to acknowledge their gratitude and appreciation to the European Commission, all partners, stakeholders and users/citizens for their contribution to this use case. Special thanks to other Inria members of Green Services Use Case team: Anne-Laure Negri for her contribution in Ideation methods and UX measurement methodology, Guillaume Pilot, Xavier Augros, Mylène Leitzelman and Semi Gaieb for MyGreenServices development, Bonacina Florian for his support in user interface design and communication aspects and Bernard Senach for the improvement of IoT installation guides on ergonomics aspects. Thanks also to Arnaud Cristini of the Air Noise Environmental Monitoring Department of Nice Côte d'Azur Metropol, Georges Gallais from VULOG, Didier Dufournet and Claire Maçon of Azimut Monitoring SME and Jérome Boyé of CKAB SME and Thierry Marcou from Fing for their support in the Use Case setting up and finally the i-lab (Numtech, CLIME Inria team) in collaboration with Air PACA agency for their study on IoT data assimilation in real time. Inria thanks also the International Design for All Foundation for having selected MyGreenServices as "Good Practice" for the awards 2014 (http://designforall.org/new/awards.php).

About the Authors

Brigitte Trousse received the M.Sc. degree in Mathematics (1984) and the Ph.D. degree in Computer Science (1989) all from the University of Nice, Sophia-Antipolis, France. She is a permanent research scientist at INRIA since 1990. She was head of the "AI in Design" (AID) research group then of the AxIS research team until 2013 (www-sop.inria.fr/axis). She conducted more than 25 years interdisciplinary research in Artificial Intelligence in collaboration with researchers in human sciences (Ergonomics, Cognitive Psychology, Linguistics, Semiotics, Sociology, etc.) related to user centred design support tools. Her research interests in AI in Design are mainly in knowledge engineering, reasoning technics, CSCW, case-based reasoning, recommender systems and these last years in usage mining, web mining, user co-creation, user experience modelling and measurement, user driven innovation and living lab process in the context of smart cities and health&well-being. From 2008 she has been very active in the European community of living labs (ENoLL). As Inria representative of ICT Usage Lab which is founding member of ENoLL, she was elected member of the ENoLL administration council in 2010. She was also elected President of the new association France Living Labs in 2012. In the context of the ELLIOT project, she was the scientific responsible for Inria partner.

Dr. Marc Pallot is Senior Research Associate at the Nottingham University Business School. He teaches "User Driven Innovation" at ISTIA Innovation and ENSAM Engineering School. His fields of interest are among Future Internet, Smart cities, Experiential Design, User Experience, Collaborative Innovation, User Co-creation, Open Innovation ecosystem (Living Lab) and eCollaboration. He has 17 years industrial experience (1978-1995) within R&D and product marketing & engineering in various sectors such as Telecom, Avionics, Defense, Engineering and CAD/CAM/PDM. He was formerly Vice-President for Product Marketing & Engineering at Win Technology, a software house specialised in Workflow and Product Data Management.

Caroline Tiffon is sociologist specialized in urbanism and new technologies. She is interested in the involvement of citizens in co-creation process and questions concerning appropriation of new behaviors. She was part of the AxIS research team at Inria during the deployment of Green Services Use Case within the ELLIOT European project (2010-2013): she was involved in engaging citizens in all the eXperiential process steps, in community management and in measuring citizens'user experience mainly for the two versions of MyGreenServices.

Developing Public Virtual Services – Case VIRTU Project

Anne Eskelinen & Ari Heikkinen, Laurea University of Applied Sciences, Finland

Abstract

VIRTU — Virtual Elderly Care Services on the Baltic Islands — was a three-year EU project funded by the Central Baltic Interreg IVA programme. The project was carried out in Estonia, mainland Finland and the Åland Islands during the years 2010–2013.

The VIRTU project aimed to develop a qualitative and cost-effective virtual service model in the field of social and health-care services in the archipelago areas. The target was to support elderly inhabitants coping at home, to increase quality of life through social interaction and to promote safe living at home. The aim was to support and engage professionals working in social and health-care services to take advantage of the technological innovations as a part of their daily work and to develop preventive working methods and practices in elderly care. Development work was done in cross-border co-operation with project partners such as municipalities, universities of applied sciences and development centres in Estonia.

The ambition was to test, develop, research and disseminate new virtual elderly care services based on technology in co-operation with the project partners. The form and level of services were designed to meet the needs of the elderly and of those who work with them. The project aimed to attach the new service model to the current social and health-care services provided by the municipalities.

This article will deal with the critical points of the development work: the commitment of the project partners and co-operation at the various levels at which the project was organised, the way in which the project was coordinated and the significance of the internal and external evaluation.

Keywords

Development work, virtual service, commitment, network

Case VIRTU project

The VIRTU project was a development project in which municipalities, universities of applied sciences, development centres, private and third-sector actors and elderly people developed interactive distance services in co-operation with one another during the years 2010–2013. The VIRTU project was carried out in 16 municipalities in Finland, the Åland Islands and Estonia. Four universities of applied sciences in Finland and the Åland Islands and two development centres in Estonia took part in the project. (Tuominen, 2013, pp. 10-18.)

The project's objectives were as follows: 1) to develop a qualitative and cost-effective virtual service model in the field of social and health-care services in the archipelago areas; 2) to support elderly inhabitants coping at home and increase their quality of life through social interaction as well as to promote safe living at home; 3) to support and engage professionals working in social and health-care services to take advantage of technological innovations as a part of their daily work; 4) to exploit cross-border cooperation by developing joint solutions to common problems in the field of social and health-care services in the archipelago areas; and 5) to help develop the service model into a profitable and transportable business concept (VIRTU Project, 2010).

The aim of the project was to create a virtual, interactive service model that benefits elderly people living in the archipelago areas. The service was called the VIRTU channel. Videra LTD's video conference system, CaringTV, was chosen as the platform for the service. It allows the elderly to communicate with other users and social and health-care professionals. (Tuominen, 2013, p. 12.)

The project organisation defined the criteria for the clients at the beginning of the project. The project partners found it difficult to define the exact elderly group that would benefit from the interactive virtual services. For that reason, the defining criteria were broad in scope: the users had to be over 65 years old, live in the project area and have either a family caregiver, live alone or be living with a partner. All in all, about 90 elderly people living at home took part in the project. (Tuominen, 2013, p. 15.) The users' average age was 79, and their functional capacity was good (Santamäki, Fisher, Häggblom, Julin, & Nygård, 2013, pp. 111-128).

The VIRTU channel (Figure 1) gave the elderly the opportunity to participate in a variety of virtual services, such as interactive broadcasts. Group broadcasts took place in the so-called video conferencing rooms, which made it possible for 8 to 16 participants to participate at one time. The project had access to a total of seven video conferencing rooms in the project area. During the project, the VIRTU channel produced approximately 1 790 interactive broadcasts for different groups. (Tuominen, 2013, p. 17.) Group activities were held at least twice a week. The activities were organised by the municipalities and the universities of applied sciences. Broadcast content included, for example, information on health-related issues, physical exercise, discussion, quizzes or music.

The channel used bilateral contacts to replace the daily phone calls from home care services. Also, the VIRTU channel included reception times with a doctor and physiotherapist. The users could use the devices and virtual rooms for their own purposes at any time, such as for bilateral conversations or common virtual coffeebreaks.

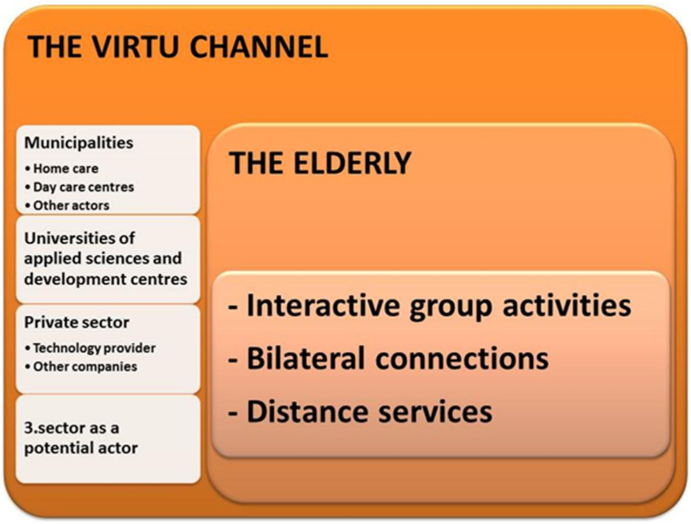

Figure 1: The service model and the main actors in the VIRTU project

Development work on the network

The project was organised on the basis of the work packages that were defined in the project application. The result was five different teams, which were responsible for the development work. The teams included 1) project management and coordination, 2) research, 3) technological testing and development work, 4) testing, development and dissemination of the service model, and 5) communication and publicity. Each team had its own targets and specified activities. Teams were assembled so that each team included participants from the different partner organisations. The teams communicated with each other through a common project group. The power to make decisions was left to the steering group, which included members from the different partner organisations.

The technological testing team joined the service model team, as their tasks were closely linked to each other. It was very important for developers to take into account technology and its advantages and limitations when developing the service model.This team had a key role in the development work.

The project was designed to develop a common virtual service model. The service model team searched for a variety of services that could be put into practice using the VIRTU channel. The aim was to combine private and public services, such as municipal–private commercial services (like a pharmacy and grocery store) and to strengthen cross-sector cooperation within municipalities (like libraries and schools). The team clarified different kinds of voluntary activities or actors as a part of the VIRTU channel.

At the beginning of the project, the development work was carried out together with all of the partners in the entire project area. The partners supported each other in planning the service model and shared ideas in group meetings and partner meetings. As the needs for virtual services and the structure of the services were different in the different municipalities, the project organisation decided to split the organisation into local pairs or groups. Municipalities, universities of applied sciences and development centres worked with local groups and handled joint development work in partner meetings and group meetings. Many services were tested in different areas, taking local needs and resources into account.

The project organisation was broad in scope, making coordination efforts complex at the different levels. For example, evaluating the project was a challenge. An external evaluator was responsible for evaluating the financier. The project organisation was responsible for conducting internal evaluations with respect to the project.

Internal assessment can be seen as an important part of self-development. Internal interim assessment gave developers the possibility to monitor, understand, guide and document the process and what was learned. It yielded information about the progress being made and it helped developers check the targets and come up with long-term visions. Internal interim assessment was done in the spring and summer of 2012, one year after starting the VIRTU channel. It was carried out by each partner in the project via round-table conversations. Internal assessment of the project helped developers to plan activities regarding the needs of the partners and review the project's goals. (Heikkinen, 2013, p. 29)

The VIRTU channel operation highlighted the co-operation that took place at the local municipal level. The channel was seen as an opportunity to cooperate with the various municipal sectors (Heikkinen, 2013, p. 32). Municipalities hired VIRTU channel coordinators, who then responded to the programming, communicated with the various actors and helped the elderly with technical problems (see Husell, 2013; Lind, 2013). In the municipalities, the project involved many people of different ages, backgrounds and professional areas; they worked together with the VIRTU service model to create services for the elderly. The project sowed a small seed among its participants, and each seed can grow into new visions of the service for the future. (Lind, 2013, p. 84.)

Co-operation between the partners was quite limited early on in the project. At the beginning, the partners focused on organising and operating their own start-ups. Collaboration improved towards the end of the project. The sharing of practical experiences was seen as an important aspect of the cooperation. Challenges to cooperation included cultural differences, regional differences and language issues.

Another aspect of the development work involved developing working methods and working procedures for home care. The development work with respect to home care was divided into three parts: virtual services, new working methods and changing attitudes towards technology. It was clear that home care professionals' knowledge and skills in the use of technology improved during the project. Coordinators organised workshops for homecare workers in the various municipalities and arranged training for them using VIRTU channel devices throughout the whole project area in Finland. The VIRTU channel was also used for meetings between project partners. (See Pekkonen &Saarikivi, 2013; Jokela, 2013)

Students at the universities of applied sciences also participated in the VIRTU project and, as a result, their knowledge of distance services and technology increased. The students were from different degree programmes, though most of them were from degree programmes social services and health care. Their feedback was mainly positive. Students from the bachelor's degree programme in social services reported that the project was a pleasant experience and that it changed their attitudes towards the elderly and elderly care in a positive manner. Not only did the VIRTU project change students' attitudes, it also offered them a meaningful learning environment in the field of elderly care and showed them how it will be changing in the future. (See Eskelinen, 2013.)

Though the VIRTU project started in May 2010, the VIRTU channel only began operating in May 2011 in Finland and the Åland Islands and in August 2011 in Estonia. Internet connections did not function properly in the archipelago at the start of the project, and this delayed the VIRTU channel start up.

Because the project was extensive, it was also complex and diverse. The municipalities involved to the project applied different services for the elderly and that is why the need for virtual services was different, too. The elderly target groups were different in the various municipalities; in one municipality, the VIRTU clients were not yet home care clients, while in another municipality the VIRTU clients only consisted of home care clients.
The project's objectives were challenging in many ways. The most important and achievable objectives were those that focused on the service model's development work, that supported the elderly coping at home and that developed home care working methods. The VIRTU project tested and piloted new services and solutions and yielded new approaches to preventive elderly care. It is evident that these objectives were met as well. Because of the short testing time, the project did not adequately exploit the cross-border cooperation and could not get the transportable business concept ready. The cross-border cooperation was done in a complex network with different kinds of actors, such as public, private and third-sector actors. The successful utilization of the cross-border cooperation would be needed more time and other recourses. (VIRTU Project, 2013.)

According to Jalonen (2013), the challenge in achieving productivity in social and health care services requires not only technological solutions, but also renewing the structures and modes of operation. In the article "The adaption of systemic innovation as an epistemic challenge", Jalonen (2013) analyses the epistemic challenges related to adopting the VIRTU channel. The uncertainty challenge had to do with customer needs, technology and project implementation with respect to the VIRTU channel. The complexity challenge was revealed in terms of the difficulty in evaluating the benefits of the project and the challenges of teaming up with different stakeholders involved in the VIRTU channel. The challenge of ambiguity was seen in the attitudes of the personnel and in trying to integrate the VIRTU channel with elderly services. The equivocality challenge was related to different means of perceiving the VIRTU channel. Its proponents viewed the VIRTU channel as a service meant to supplement traditional services or as the emergence of wellbeing services that make use of technology.

While the VIRTU project did not in the end get the cross-border service model ready in time, the project partners are continuing the development work. The project partners are searching for cost-effective solutions to providing virtual services. The necessary technology and operating models are available, but the economic issues still require solutions. The benefits are already being seen in the municipalities: virtual services increase the quality of life and prevent the elderly from feeling so lonely.

The necessity of trust and commitment in a project

The basic requirements for successful networking are trust and commitment. Both rely on the interaction between processes that either strengthen or weaken them. Networking is mostly based on trust. A lack of trust may even prevent the network from forming and is highlighted especially in challenging situations. Commitment can be defined as the desire of the participants to provide energy and show loyalty to the network organisation. Trust creates commitment, and vice versa. (Hakanen, 2012.)

For a sense of commitment, it is significant whether or not the actors have similar opinions on the definition of good service. Employees certainly have their opinions about good service. If the criterion of proper work in a technology project is overlooked, the level of commitment might suffer. The technology providers are private companies, and therefore, their objectives may differ from those involved in providing public services. Several public services, such as health and social services, are such that, by their very nature, commercial policies cannot be applied to them.

A large number of actors can create challenges. Communication may be difficult given the different educational backgrounds of people and their understanding of the content of the project activities. Professional jargon and views on the content of work and what constitutes good quality may all differ from each other. Sufficient orientation and training provide the basis for success in the technology projects.

Nowadays, it is widely accepted that work productivity must be improved in the public sector. It is believed that using technology more extensively will increase work productivity in social and health-care services, even though not on the same scale as with the production of goods. Face-to-face contact or the personal touch is not easy to rationalize according to market values (Korkman, 2013, p. 159). Service production in the public sector is a very complex field, making it difficult to foresee and measure cost-effectiveness; likewise, the public sector has more comprehensive and intangible aims for its operations than does the corporate sector (Koivumäki & Nygård, 2013, pp. 38-39).

In terms of the project activities aiming to improve productivity, it is important that different actors — public services and private technology providers — share the same understanding of the key targets of action and the means for achieving them. Sharing information is important during different phases of the project to ensure that different actors know about the development measures, progress and schedules for the project. It may happen that the staff working closest to the customers has the least amount of information about the activities and schedules for the project.

The targets of a project must be clear enough from the very beginning. The project also needs milestones that can be utilised to achieve the overall targets. The targets of the project must be known by all actors and the targets must be assessed during the course of the project. The assessment, for its part, commits the actors to the targets of the project and ensures that the actions of every participant are viable and significant. Good evaluation results confirm the motivation of the participants to work on the project.

From the perspective of elderly people living at home, the objectives of the project must naturally be customer oriented — the needs and possibilities of the customer in home health care should be at the centre of attention. Technology must also be tested in a genuine environment. In such a case, the customers themselves become committed to the development work. Challenges can raise due to the diversity of the customers and the way in which the technology functions.

The people who benefit the most from using technology can be assumed to be committed "testers" — they can be defined as experts based on experience. Experience and expertise help ensure that the project is customer oriented. User experiences should be taken into account when assessing the project activities.

Reduced preparedness of the customer may naturally set limits on his or her ability to take part in the development work and be an active actor. In such cases, a relative or an employee who knows the customer can be helpful when studying user experiences. The employee and the customer often have a close relationship. The employee knows the needs, abilities and functional limits of the customer as well as their cognitive preparedness to use and embrace new technology. It is significant that the customer can trust the employee and her or his professional ethics.

The commitment and motivation to use technology are of course affected by how well the device and programmes function. Especially at the beginning of the project, major problems existed in the VIRTU channel when introducing the technology. The action was delayed because of technical difficulties. This weakened the motivation of both the customers and employees to participate in the development work. (Tuominen, 2013, p. 15.)

Introducing technology into a project requires tendering, which is a multi-stage and time-consuming process. This shortens the time allowed for concrete work in the project. Motivation and the commitment of the actors are negatively affected by uncertainty about the technology being used and the schedule for introducing it as well as by delays in the agreed upon schedules.

The successful introduction of technology requires the simultaneous existence of certain factors concerning the technology itself. First of all, the technology must be user friendly. Second, it has to be clearly orientated towards the needs of the users. Third, the technology must be useful. Introducing technical tools and new operation models requires being prepared at every level.(Jokela, 2013, pp. 183-192.)

In addition to the working tools, the targets of the project have to be significant for the employees. Commitment is created through collectively agreed upon targets and through meaningful action. Different opinions and views during various stages of the project must be taken into account and resolved. Otherwise, the project will just be another compulsive administrative reforming process instead of goal-orientated practical work designed to reform old working methods.

Social and health services have been largely outsourced to private services. Due to the commercialising of the services, employees may feel a lack of motivation and even fear developing their own work. The previously preferred values, operation models and overall targets may disappear when developing the service towards a more commercial phase.

Traditional care and entrepreneurship with respect to the care sector have different values. The blurring of the boundary between employee and entrepreneur may raise suspicions about the ethics and motives of the care worker (Hasanen, 2013, pp. 332-333).

Due to new possibilities to organise (outsourcing), employees may feel great uncertainty concerning their own work and income. It is also noteworthy that all people requiring the care cannot act as consumers who make their own choices and take responsibility for themselves (See Kuusinen & Seppänen, 2013, p. 318).

The "Social embeddedness of innovation process" and "social shaping of technology" as concepts describe the boundary conditions of the technological innovations. When introducing new innovations, human actions also need to be taken into account. The spread of innovations requires changes in social relationships and in working practices. Technological innovations may at best enable a new type of interaction and different practices. (Husso & Seppälä, 2008, p. 50.)

In the event that the desirable changes and actions are clearly agreed upon and known in advance, people can more easily commit to them. The actions taken after completing the project are significant from the standpoint of such commitment. Do the different parties consider the objectives of the project worth pursuing?

Conclusion

While the targets of the VIRTU project have many of the same features as the targets of private companies seeking innovation and productivity, they are also characteristic of the public sector when taking into account the project's development work. The development work and project activities aimed not only to intensify services, but also to maintain and improve quality. Co-operation between elderly, their relatives, public and private service providers, and third-sector actors was needed when developing the targets.

According to Rantanen and Heikkinen (2013, p. 59), due to social and political changes the relationship between the customer and employee has expanded into a network where various actors have different roles. Welfare technology has changed the operational environment in more complex ways than ever: interactive virtual services, the associated hardware and support service subscriptions, and content production necessitate cooperating with new actors.

The changes can also be complex at the municipal level. The service systems of municipalities differ from one another for several reasons. Each municipality decides on their need for outsourced services and buys them from private companies and third-sector organisations.

The situation of the customer is affected by the expansion of private services. As a result, two approaches can be taken when studying the frame of reference of social services created by the market. First, the customer's ability to make choices as a consumer should be highlighted. The consumer's choices impact the market. On the other hand, the customer may not be able to make choices as a consumer. This requires new collective ways of working that can be utilised when strengthening the service user's position and level of inclusion. (Toikko, 2012, pp. 113-114.)

Those who use elderly services may also be able to decide for themselves what is best. However, an elderly home care client often needs help at home and when choosing different services. In the event that employees have sufficient technological know-how, they can transfer their knowledge to the customers and co-operate with them. It is important that employees receive adequate training and become oriented to the new technologies at the right time.

It is easier to implement technology when the employee and customer have a good relationship. It is important to consider the older home care clients as a heterogeneous group. What is good for one client might not be good for another. People live their own lives.

The VIRTU project and other projects aiming to make better use of technology affect existing working methods, promote the emergence of new co-operation methods and create pressure for organisational changes. As was previously mentioned, the level of co-operation across the sectoral borders of public services was relatively minor. However, by the end of the project as well as afterwards, there have been several signs of the expanding opportunities to make use of the VIRTU channel among new user groups.

A significant result of the VIRTU project was that we obtained real experiences from those involved in development work in the network. After the project, activities have been further developed in the municipalities and also new user groups have been identified. In addition to the fact that awareness about the necessity to change increased, participants in the study became more familiar with technology and the new opportunities for using it. Best of all, many of the elderly users had positive experiences with the technology.

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About the Authors

Anne Eskelinen is a senior lecturer at Laurea University of Applied Sciences. She has a master's degree in Music from the Sibelius Academy. She worked as Laurea's project manager in the VIRTU project. She has also participated in other development projects in which the focus has been on creative activities, virtual services or elderly care. Her interest is in developing Laurea's Learning by Developing model in practice.

Ari Heikkinen is a senior lecturer at Laurea University of Applied Sciences, where he has taught for many years. He has a licentiate in Education and a master's degree in Social Sciences. He worked as a developer and evaluator in the VIRTU project. His interest is in developing the quality of education.

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www.laurea.fi/isj

Publisher:
Laurea University of Applied Sciences
Ratatie 22, FI-01300 Vantaa, Finland

Printed by:
Edita Prima Oy
ISSN 1799-2710