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Potentials of Living Labs for the Diffusion of Information Technology: A Conceptual Analysis

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Abstract. In the past, the development of information systems (IS) for companies was mostly driven by experts from the information technology (IT) department. Up to today, the users' experiences, valuation of usability and suggestions for improvements have become important components in the research and development (R&D) process in order to ensure efficiency, usability and sustainability of the IS. Many newly developed IS components do not fail in terms of usability and effectiveness due to a lack of advanced technology, but because of failure to understand the users' needs. Living Labs - open innovation environments - offer a unique opportunity for IT departments to involve users at each stage of the R&D process.
The objective of this paper is to provide a conceptual framework for discussing the question to what extent the Living Lab methodology is able to overcome problems concerning the diffusion of IT. Therefore, major challenges will be deduced from factors that influence IT adoption: characteristics of the technological innovation, communication channels and social context. Afterwards, potentials of Living Labs for the diffusion of IT, i.e. to what extent this methodology is able to meet the major challenges, will be analyzed.

Keywords: Living Lab; information technology; diffusion; open innovation; user orientation

1 CHALLENGES FOR THE DIFFUSION OF INFORMATION TECHNOLOGY

Nowadays, IT is the backbone of almost all distributed business processes in a company's daily business. Efficiency, usability, capacity and sustainability of an IS are the result of interaction between the requirements of a company and the design of technology that is supposed to meet them. Since IT is implemented in order to

improve productivity, it must be accepted and used by the employees: IT needs to be diffused.

For many decades, researchers repeatedly reviewed the diffusion of IT and developed frameworks to guide future research, e.g. Fichman (1992) in his seminal paper on "Information Technology Diffusion: A Review of Empirical Research". We rely on the more recent work of Peansupap et al. (2005) who used theories of innovation diffusion, change management and learning and sharing knowledge to develop a framework for influencing users' diffusion of IT within a company. He claimed that the success of diffusion is determined by three factors that influence IT adoption: characteristics of the technological innovation, communication channels and social context.



Fig. 1. Factors of innovation diffusion (Peansupap et al. 2005)

In the following, certain major challenges for the diffusion of IT will be deduced from these three factors.

1.1 Challenges regarding characteristics of technological innovation

There is no general solution for the diffusion of IT that can be applied to all companies, because the procedures, employees etc. are different. A special selection of software and subsequent adaption to the company needs is necessary. Therefore, the relevant parameters in the selection of systems need to be examined, e.g. what is processed, are special wizards needed etc? To ascertain these parameters, real and virtual concepts that support user-centred and innovation-oriented R&D have to be created.

1.2 Challenges regarding communication channels

New IS should not replace existing systems without user tests and validation. This requires a specific research infrastructure, which grants IT departments access to user-centred research: a user experience prototyping environment. Therefore, to ascertain data and to increase the user experience and observation, new models are necessary.

1.3 Challenges regarding social context

User problems with the IS have to be detected and suggestions for improvements confirmed. More influence and room has to be granted for providing expertise and participation in the conceptualizing of the IS. Therefore, the users have to be involved as "co-creators" and the IT professionals have to be sufficiently trained to mentor the users. Teamwork has to be fostered.

2 LIVING LABS

The Living Lab approach originates from the Massachusetts Institute of Technology in Boston and owes its existence to the work of William Mitchell. Living Labs are certain environments or methodologies created with the aim of involving users in innovation and R&D. The task of a Living Lab can be summarized as shown in figure 2: it brings users early into creative processes, bridges the innovation gap between technology development and the uptake of new products, and allows for early economic implications of new technological solutions.

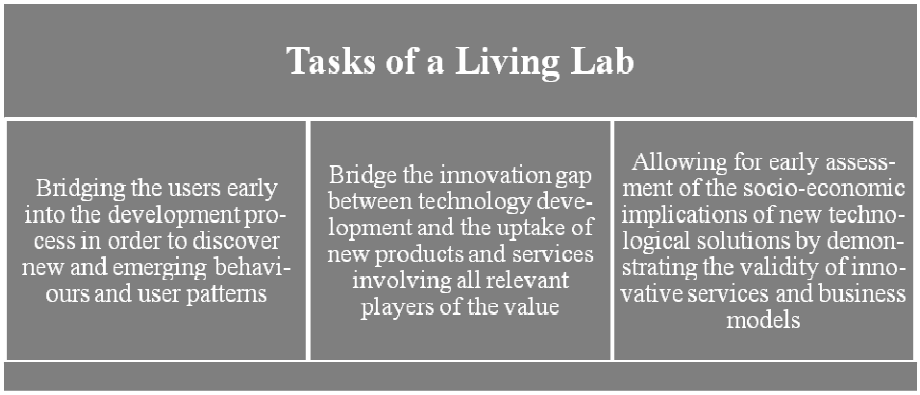


Fig. 2. Tasks of a Living Lab (Mulder et al. 2009)

In order to come up with a comprehensive overview of Living Labs and to analyze their respective characteristics, secondary literature was analyzed with regard to Living Lab definitions. Only the most commonly used and most frequently cited definitions will be compared. The characteristics user-centered, real testing environment, regionality, ICT, public-private partnership (PPP) and open innovation are the key words of single definitions, and allow to clearly work out differences and similarities of the definitions.

Table 1. Analysis of the Living Lab definitions

Definition	User- centred	Real testing environment	Regionality	ICT	PPP	Open innovation
"Living Labs represent a user-centric research methodology for sensing, prototyping, validating and refining complex solutions in multiple and evolving real life contexts" (Livinglabs 2010).	x	x				
"A Living Lab is a city area which operates a full-scale urban laboratory and proving ground for inventing, prototyping and marketing new mobile technology applications" (Living Labs Europe 2010, p. 2).		x	x	x		
"Living Labs are open innovation environments in real-life settings, in which user-driven innovation is fully integrated within the co-creation process of new services, products and societal infrastructures in a regional harmonized context (the "Open Innovation Functional Region") catalyzing the synergy of SMEs Collaborative Networks and Virtual Professional Communities in a Public, Private, People Partnership" (Santoro 2009, p. 1).	x	x	x		x	x
"Living Labs are open innovation environments in real-life settings, in which user-driven innovation is fully integrated within the co-creation process of new services, products, and societal infrastructures" (Mulder et al. 2009, p. 1).						
"Living Labs represents a research methodology for sensing, validating and refining complex solutions in multiple and evolving real life contexts. Here, innovations, such as new services, products or application enhancements, are validated in empirical environments within specific regional contexts" (Schumacher et al. 2007, p. 1).	x	x				
"Living Labs are environments for involving users in innovation and development, and are regarded as a way of meeting the innovation challenges faced by information and communication technology (ICT) service providers" (Følstad 2008, p. 99).	x	x		x		
"The living lab concept creates innovation ecosystems that bring policy stakeholders and players of the value network including SMEs and end-users (citizens) early into the innovation process to discover new and emerging user patterns and allow for early experimenting and validating new products and services" (Schaffers et al. 2010, p. 3).	x	x			x	
Total	5	6	2	2	2	1

The number of ticks shows that "real testing environment" and "user- centered" are the lowest common denominator. These two characteristics influence the definition for this paper:

Living Labs are open innovation and real testing environments in real life context, in which user-driven innovation is fully integrated into the co-creation process of new services and products.

The Living Lab methodology is based on the theory of Open Innovation, which was defined by Chesbrough (2006) 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" (Chesbrough 2006, p. xxiv). In this case, companies acknowledge the potential of users as co-creators.

3 POTENTIALS OF LIVING LABS FOR THE DIFFUSION OF INFORMATION TECHNOLOGY

The potentials of Living Labs are conceptually analyzed to meet the challenges of the diffusion of IT by referring to the Living Lab characteristics "real testing environment" and "user-centred design".

3.1 Real testing environments

There is a need for a specific infrastructure granting IT professionals access to the users. The infrastructure should support the involvement of users within the R&D process of the IS "in order to better understand the relationship between new innovative concepts and related users' behaviour within specific situations as well as potential cognitive workload in interpreting received signals" (Pallot et al. 2010, p. 16).

Technological innovation challenge: Implementation of rooms.

IT departments attempt to enhance their innovation capacity through opening the R&D process. The users' feedback is taken into consideration in order to better understand the several needs of the different departments and to customize the IS. A basic metaphor for openness is the space-metaphor that manifests itself in a virtual or real way. Examples are "enterprise 2.0", "virtual communities" and the "entrepreneurial design thinking" approach. Such physically real and digital-virtual space concepts support innovation-oriented R&D. Living Labs as open spaces realistically depict the situation of users in particular, thus make it tangible for the IT department.

Communication channels challenge: Development of new models and tools.

Companies have to deal with the management of large, complex and heterogeneous socio-technical systems that integrate human, technological and environmental

elements. For that purpose, the models incorporate socio-cognitive, cognitive ergonomic, socio-emotional and economic aspects to increase the quality of user experience and observation.

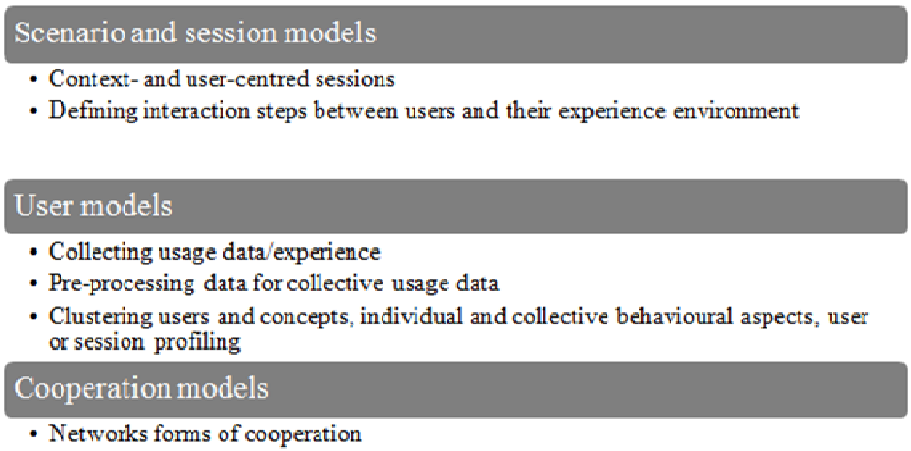


Fig. 3. New models (Pallot et al. 2010)

All models entail growing data sets. As a consequence, data acquisition, data mining and user experience research techniques have to be improved.

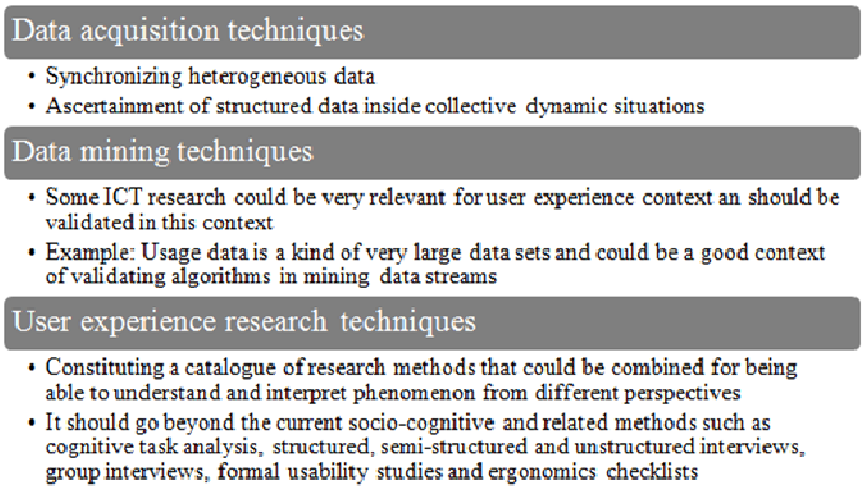


Fig. 4. New techniques (Pallot et al. 2010)

The models and techniques can be implemented in Living Lab as standard from an external consultant. This kind of tool box can be used in every context.

3.2 User-centred design

Living Labs are characterized by the "users as innovators" approach, meaning that "the basic idea is not about using the users as 'guinea pigs' for experiments, it's about getting access to their ideas and knowledge" (Gonçalves et al. 2007, p. 283).

Technological innovation challenge: Usage of internal resources.

IT professionals are often not aware of the potential of integrating their own employees, because they underestimate the users' understanding of IT etc. Furthermore, it is often time-consuming and expensive to obtain information about user behavior or emerging problems. However, to solve a problem the needed information (user) and problem-solving capabilities (IT departments) must be brought together (von Hippel 1994). A Living Lab solves this problem by providing rooms and methods to involve the employees in the R&D process.

Communication channels challenge: Methodologies for user integration.

To facilitate co-creation, each stage of the innovation process has to be supported by traditional and collaborative working environment (CWE) methods.

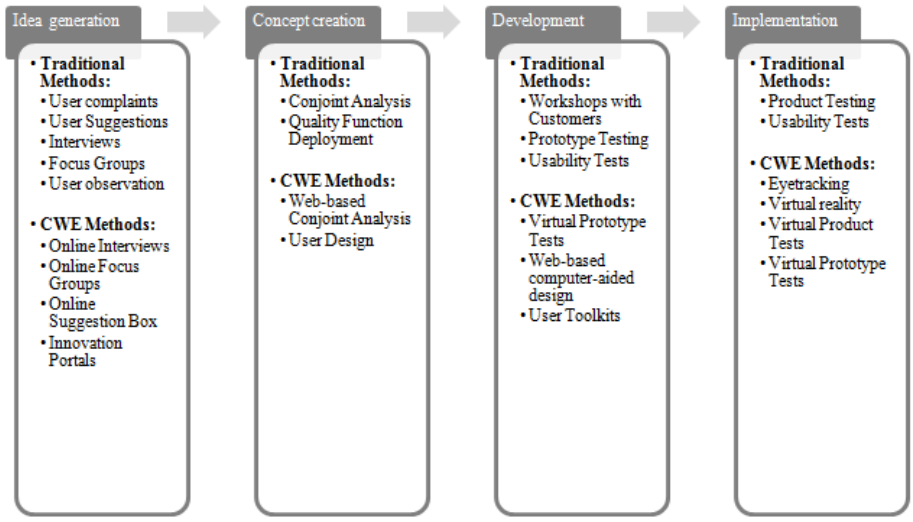


Fig. 5. User integration methods (Reichart 2002; Mulder et al. 2009; Schumacher et al. 2007)

"Traditional methods, of course, have their value in ethnographic research, however, they might not exploit Living Labs as an infrastructure that comes close to the user as well as make use of the potential of Living Labs as a methodology to get richer insights in what drives people" (Mulder 2009 et al., p. 4).

Social context challenges: User as "co-creator" and the role of IT professionals.

Holtzblatt (2001) wrote that "great product ideas come from a marriage of the detailed understanding of a customer need with the in-depth understanding of technology. The best product designs happen when the product's designers are involved in collecting and interpreting customer data and appreciate what real people need" (Holtzblatt 2001, p. 19). A Living Lab allows the integration of the users in the R&D and supports innovations that are "validated in collaborative, multi-contextual, empirical real-world environments" (Kusiak 2007, p. 867).

IT professionals usually serve as translators for users and programmers. Within Living Labs, they change between being translators and facilitators for new tasks.

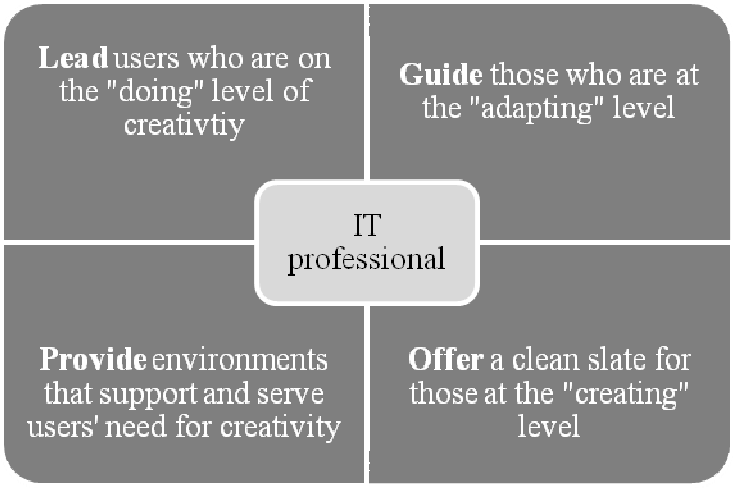


Fig. 6. Tasks of an IT professional (Sanders et al. 2008)

To offer relevant experiences to facilitate user expressions of creativity, leading, guiding and providing a corresponding environment to encourage users is necessary.

4 CONCLUSION, LIMITATION AND FURTHER RESEARCH NEEDS

In response to the challenges of the realization of employees' internal potential and for the purpose of improving the effectiveness of policy instruments to support the development of sustainable IS, a stronger orientation towards interactive learning within companies is necessary (Nauwelaers et al. 2006). This analysis is just conceptual: Propositions have to be deduced and hypotheses have to be proven in the future.

The static factors (characteristics of technological innovation, communication channels and social context) can be used to determine the primary individual's adoption decision (Peansupap 2005). Nevertheless, these factors do not explain the

dynamic nature of the diffusion processes that drives innovation. Peansupap (2005) identified two dynamic factors: "change management" and "learning and sharing of knowledge". They compliment the static factors and involve supportive change mechanisms that facilitate the diffusion of IT.

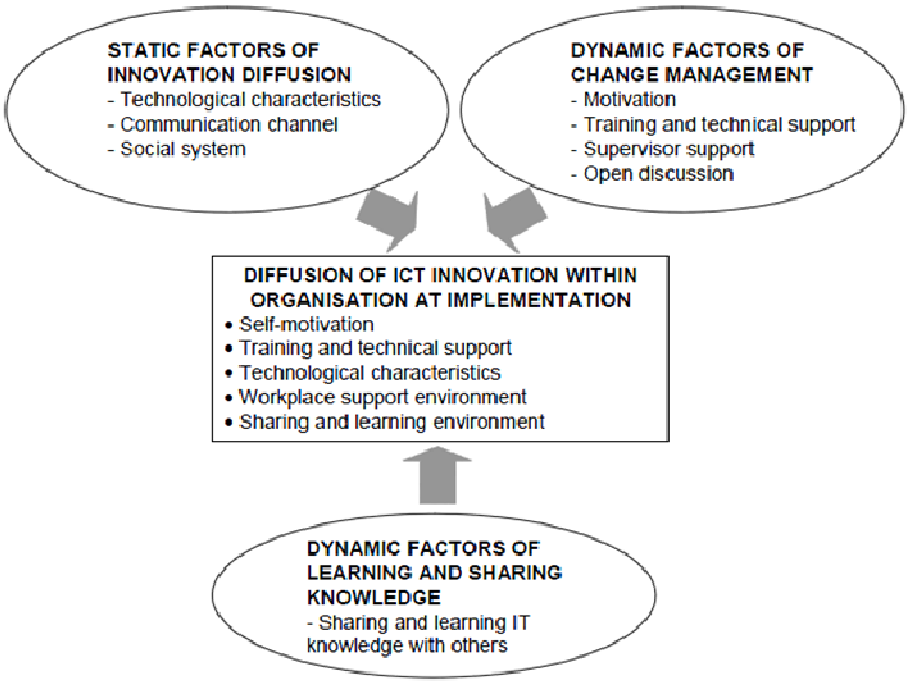


Fig. 7. Integration of factors related to IT diffusion (Peansupap et al. 2006)

Living Labs can build the basis for the static as well as the dynamic factors, because they bring all stakeholders early into the R&D process

- to discover new and emerging user patterns,
- to allow early experimentation and validation of components of the IS and
- to customize or improve existing components.

Nevertheless, the implementation of a Living Lab is a expenditure, because the rooms have to be implemented and users have to be trained to use the tools. It has to be checked whether the gains in efficiency, the cost savings and the improvements are at an appropriate rate compared to the efforts. Also, it needs to be determined whether the company can operate the IS on its own or whether this results in further costs for consulting and administration, because hiring external companies or further employees gets necessary.

However, a Living Lab facilitates the development of a user-friendly IS that is adjusted to the sustainable fulfillment of tasks.

This paper was confined to a specific context, and other topics have to be explored. Research, for example, needs to be conducted in order to learn in greater detail how and why individuals adopt new information technologies.

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