A Milieu for Innovation – Defining Living Labs

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Abstract: A new trend of user involvement in open innovation processes has emerged. Concurring with this trend the Living Lab concept has been re-vitalized. This concept has attracted attention lately, but there exist no coherent view. In this paper we discuss and define the concept and propose five key components and five key principles for Living Labs based on experiences from over 30 development and research projects within two Living Labs, Botnia Living Lab and Halmstad Living Lab. The key components are: ICT & Infrastructure; Management; Partners & Users; Research; and Approach. The key principles are: Openness; Influence; Realism; Value; and Sustainability. Our proposed definition of a Living Lab is: A Living Lab is a user-centric innovation milieu built on every-day practice and research, with an approach that facilitates user influence in open and distributed innovation processes engaging all relevant partners in real-life contexts, aiming to create sustainable values.

Keywords: open innovation; living lab; definition; principles; openness; influence; realism; value; sustainability; users

1 Introduction

Open innovation has attracted a lot of interest among scholars from different disciplines. Research on open innovation argues that making use of external as well as internal

resources increases firms' ability to innovate (Chesbrough, 2006). In contrast, closed innovation represents a paradigm that primary merely uses internal resources within a firm's innovation processes. Open innovation is a paradigm that transcends the boundaries of the firm in creating customer value (Chesbrough, 2006).

Adding to this movement there is a trend to involve end-users in the innovation processes to ensure useful and usable products and services. There are different approaches to how this can be achieved; two of the more well-known approaches are the "lead user" concept by von Hippel (von Hippel, 2005) and "crowdsourcing" by Howe (Howe, 2008). Lead users are defined as users that are ahead of the majority of the general market with respect to a specific trend and are expected to gain relatively high benefits from a solution to the needs they have encountered (von Hippel 2005). As such, they could be very useful to involve in firms' innovation processes. Crowdsourcing represents the act of a company or institution taking a function once performed by employees or suppliers and outsourcing it to an undefined (and generally large) network of people in the form of an open call (Howe, 2008).

Lately, a new phenomenon is emerging, called Living Lab (Eriksson *et al*., 2006; Bergvall-Kåreborn & Ståhlbröst, 2009; Svensson & Ihlström Eriksson, 2009a). Concurring with the open innovation paradigm, Living Labs draw on the notion of external ideas as a resource in innovation. Such an approach primarily aims at supporting innovation processes that lead to usable products and services. In a Living Lab approach e.g. researchers, firms, users, public partners and stakeholders of emerging technology collaborate in innovation processes in real-world settings.

Comparing Living Lab with open innovation we identify three differences (Table 1):

Table 1 Living Lab compared to open innovation

Living Lab	Open Innovation
Business to consumer with a clear focus on user involvement (Ståhlbröst & Bergvall-Kåreborn, 2008; Svensson *et al*., 2010)	Business to business (Chesbrough, 2006)
Focus on the product/service (Eriksson *et al*., 2006)	Focus on the business model (Chesbrough & Appleyard, 2007)
External input in the whole innovation process (Svensson & Ihlström Eriksson, 2009a; Ståhlbröst, 2008)	External input focuses on ideas and technology (Smith, 2004)

Due to the newness of the Living Lab concept, there is a need for clarification. Therefore, the aim of this paper is to add to the existing literature on open innovation by describing and defining the Living Lab concept. Botnia Living Lab is situated in the north and Halmstad Living Lab is situated in the south of Sweden. Together the Living Labs have experience from over 30 research and development projects.

2 Defining Living Lab

The concept of Living Labs originates from Professor William Mitchell at MIT, where it initially was used to observe the living patterns of users in a smart/future home for a period of time. Today, there is an ongoing trend in Europe to tailor a Living Lab concept in wider use to "enhance innovation, inclusion, usefulness and usability of ICT and its applications in the society" (Eriksson, *et al*., 2005, p. 5). In order to join forces,

coordinate activities and share learning experiences, a European Network of Living Labs (ENOLL) [1] has developed. Today, the network consists of 129 Living Labs after the third recruitment wave have finished. Both Botnia Living Lab and Halmstad Living Lab are members of ENOLL.

There exists no coherent definition of Living Labs, although several actors have expressed their own definitions. Below we will exemplify with several definitions to show the diversity in the field and argue for our proposed definition.

There exists definitions from networks, EU-projects and funders of research: according to the European Network of Living Labs [1] a Living Lab is "both a methodology for User Driven Innovation (UDI) and the organizations that primarily use it" while the European project CoreLabs [2] defines Living Labs as "a system enabling people, users/consumers of services and product, to take active roles as contributors and co-creators in the research, development, and innovation process". Furthermore, Living Lab can be viewed as "an arena for innovation. It is a structure and a long-term societal resource rather than related to a certain project. Within this structural framework, experiences, routines and conditions are built to develop ideas into innovations" (VINNOVA, 2009).

Several scholars have also presented definitions: Eriksson *et al*., (2005) defined Living Lab as "a user-centric research methodology for sensing, prototyping, validating and refining complex solutions in multiple and evolving real life contexts" (p. 4). Ballon *et al*., (2005) define Living Lab as an experimentation environment in which technology is given shape in real-life contexts and in which (end) users are considered 'co-producers'. Moreover, Feurstein *et al*., (2008) describes Living Lab as a systemic innovation approach in which all stakeholders in a product, service or application participate directly in the development process.

Hence, the concept of Living Labs can be seen as a methodology, an organization, a system, an arena, environment and/or a systemic innovation approach. Based on our experience in the area we argue that a Living Lab is both a milieu (environment, arena) and an approach (methodology, innovation approach). Furthermore, we base our definition on the components and principles that characterize Living Labs (see below). Therefore, our definition is as follows:

> *A Living Lab is a user-centric innovation milieu built on every-day practice and research, with an approach that facilitates user influence in open and distributed innovation processes engaging all relevant partners in real-life contexts, aiming to create sustainable values.*

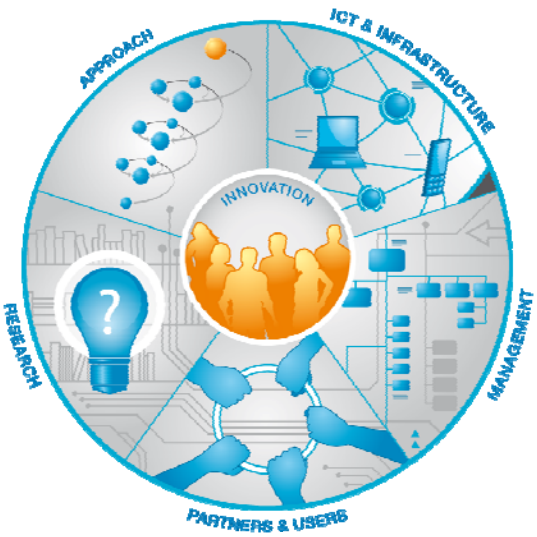
Since Living Lab is a rather new phenomenon that emerges in such diverse areas as e.g. ICT-development, health services, and rural development, it is a hard concept to describe. Due to this, different suggestions for key elements and characteristic have been suggested (see for example Eriksson *et al*., 2006; Feurstein *et al*., 2008; Mulder *et al*., 2007). To coordinate the on-going activities around Europe towards the establishment of a European Network of Living Labs, a Coordination Action project called CoreLabs was developed and carried out between 2006 and 2007. From this project a number of reports were delivered with the aim to gain insights into the Living Lab phenomena. Based on these reports, but modified according to our own experience (Bergvall-Kåreborn *et al*., 2009; Bergvall-Kåreborn & Ståhlbröst, 2009; Ståhlbröst, 2008; Ståhlbröst & Bergvall-Kåreborn, 2008, Svensson *et al*., 2010, Ihlström *et al*., 2009), we have defined five key

components of a Living Lab milieu and five key principles for the Living Lab approach. These are presented in the two following subsections.

2.1 Living Lab Key Components

The key components of Living Labs are illustrated in figure 1. The *ICT & Infrastructure* component outlines the role that new and existing ICT technology can play to facilitate new ways of cooperating and co-creating new innovations among stakeholders. *Management* represent the ownership, organization, and policy aspects of a Living Lab, a Living Lab can be managed by e.g. consultants, companies or researchers. The Living Lab *Partners & Users* bring their own specific wealth of knowledge and expertise to the collective, helping to achieve boundary spanning knowledge transfer. *Research* symbolizes the collective learning and reflection that take place in the Living Lab, and should result in contributions to both theory and practice. Technological research partners can also provide direct access to research which can benefit the outcome of a technological innovation. Finally, *Approach* stand for methods and techniques that emerge as best practice within the Living Labs environment.

Figure1 Living Lab Key Components



Botnia Living Lab is hosted by the Centre for Distance-spanning Technology (CDT) at Luleå University of Technology. A board of directors with industrial majority sets the strategic direction for the Living Lab while CDT provides the technical infrastructure, manages the partnerships, and is responsible for tactical planning and daily operations. The research carried out at Botina centers around ICT products and services and includes areas such as technical infrastructure; user centered and context aware applications; business models; and new methods and tools suitable for Living Lab.

Halmstad Living Lab is hosted by Halmstad University, which also provides the infrastructure and ICT, and is managed by researchers. The partners are e.g. SMEs in the health technology sector, NGOs, municipalities and media companies with different user

groups such as seniors or media users. The research conducted in the Living Lab concerns open digital innovation processes and methods and tools for multi stakeholder involvement processes. Special attention is given to the Living Lab approach and how to find methods and tools for involving stakeholders in distributed activities.

2.2 Living Lab Key Principles

The five key principles for Living Labs are illustrated in figure 2. Below we describe the five key principles: Openness, Influence, Realism, Value and Sustainability. As the Living Lab concept is multi-disciplinary, we will discuss these principles with reference to literature from related areas such as economy, innovation, organization, information systems, participatory design and human-computer interaction.

Figure 2 Living Lab Key Principles

Openness

In open innovation literature (Chesbrough, 2006) the perspective of openness is of concerns firms driving innovation processes to reach for example new products, services or new markets. However, openness can also be discussed based on e.g. an individual, team or firm level. In these cases openness concern how to support open mindsets on an individual or team level or openness and knowledge transfer between different levels in an organization. Openness can also be seen as an overarching philosophy that is being used as the basis of how various groups and organizations operate.

In a Living Lab, digital innovations are created and validated in collaborative multi-contextual empirical real-world environments. Openness is crucial for the innovation process in a Living Lab, where it is essential to gather a multitude of perspectives that might lead to faster and more successful development, new ideas and unexpected business openings in markets. However, to be able to co-operate and share in a multi-

stakeholder milieu, different levels of openness between the stakeholders seems to be a requirement. To stimulate creativity and create new ideas that can be turned into applications and bring value through use, Eriksson *et al*. (2005) suggest open collaboration between people of different backgrounds, with different perspectives that have different knowledge and experiences. More people, including consumers, need to be involved in the innovation process. This is argued by Thomke and von Hippel (2002) who claim that users are often the source of innovations. The concept of user driven innovation (von Hippel, 1988) suggests that users are capable innovators. Thereby it can be argued that involvement of end users or consumers in the innovation process is important, hence they should be vital part of an innovation system.

It could be expected from a business and innovation perspective that smaller enterprises might have strong incentives to be involved in Living Lab processes. Small and micro enterprises often lack the resources and knowledge that larger organizations have. One way to strengthen smaller enterprises' innovation capacity is by collaborating with other actors such as academia, the public sector and other enterprises (Eriksson *et al*., 2005). Living Lab and similar innovation milieus might thereby strengthen the innovation capacity due to cross-fertilization and open collaboration between different actors. The Living Lab may also provide an arena where different stakeholders are needed to in order to commercialize and bring products and services to market, either support existing relations between business stakeholders or as a milieu where new partners get the chance to meet and collaborate.

In our projects we have experienced openness on different levels, but we have also experienced when processes close up due to e.g. IPR issues. The challenge is to create a milieu where stakeholders are motivated to and have incitement to share knowledge. Specifically business stakeholders might need economically tangible incitement whereas user groups often are driven by other motives. These motives need to be identified and acted upon. Furthermore, the motives for engagement might also differ quite radically depending on the specific Living Lab context.

Influence

A key aspect of the influence principle is to view "users" as active and competent partners and domain experts. As such their involvement and influence in innovation and development processes shaping society is essential. Equally important is to base these innovations on the needs and desires of potential users, and to realize that these users often represent a heterogeneous group. This means utilizing the creative power of Living Lab partners, whilst facilitating their right to influence these innovations. By stressing the decision making power of potential users and domain experts the principle differs from related concepts such as participation, involvement, and engagement which instead focus on the activities carried out by users and users' psychological state (Barki & Hartwick, 1989; Baroudi *et al*., 1986).

In order to reduce the diversity and ambiguity related to the principle of influence, and to increase its positive impact in practical studies, it is prudent to define and explain the concept as clearly as possible. To manage this we propose three dimensions linked to influence: why, who, and how. When it comes to the *why* of influence, two motivations can be identified in the literature: a political and a technical perspective. The political perspective is based on the central tenet that users have a moral right to influence technological decisions affecting their private and professional life. The technical perspective is founded on the notion that the effective participation of skilled users can

contribute to high quality products as well as system acceptance. The *who* of influence is related to making reflective choices on who to involve in a particular study while the *how* refers to the process of participation and on different degrees of participation and influence linked to different partners.

Based on our experience the meaning assigned to the principle of influence differs quite a lot among different partners and users. However, to take the step from participation or involvement to influence, domain experts' and users' needs and ideas should be clearly traceable in concepts, prototypes, and the finished product. In all our projects users have exercised influence over the design of the final systems; their needs and suggestions have influenced the design and been implemented as functions and features in the prototypes and final systems. However, in most projects they have been given this influence because the partners kept open minds and wanted to base the solution on user needs rather than on their own predetermined view on what users like.

However, there is a reoccurring difference between how users and domain experts are portrayed and the actual roles, activities and responsibilities assigned to them (Beath & Orlikowski, 1994). While users often are described as drivers and shapers of technology they still very often are treated as a homogeneous and passive group that carry out activities assigned to them. Hence, one important issue that Living Labs need to manage is how to assure that participation, influence and responsibility among different partners harmonizes with each other and with the ideology of the user influence of the project.

Realism

One of the cornerstones for the Living Lab approach is that innovation activities should be carried out in a realistic, natural, real life setting. Orchestrating realistic use situation and user behavior is seen as one way to generate results that are valid for real markets in Living Lab operations (CoreLabs 2007). However, the aim to create and facilitate realism is an endeavor that needs to be grappled with on different levels and in correlation to different elements such as contexts, users, use situations, technologies, and partners. The principle does not separate between the physical and the online world. Instead we argue that activities carried out in both worlds are as real and realistic to its actors. Being inspired by the online reality we argue that IT based tools and methodologies can function as twin-world mediators (Attasiriluk, *et al*., 2009) which facilitate the interconnection between real-world devices and their virtual counterparts. Following Mingers and Willcocks (2004) we also argue that ideas, concepts, meanings, and categories are equally real as physical objects. These are emergent from, but irreducible to, the physical world and have causal effects both on the physical world and the social world. This means that to understand roles, behavior, and relationships related to the innovation process we need to go beneath the surface and not only focus on what is observable.

Relating realism to Checkland's real-world concept (Checkland, 1999), means that the "real-world" situation reflects people's interpretation of their current situation. People's interpretations and how they perceive the situation is related to people's worldview, or what they view as important for them; hence, what is viewed as the reality for one person does not necessarily mean the same for another person. This means that what is important and motivating for one partner, is not necessarily important to another partner, which is a rationale for why it is crucial to involve a diversity of perspectives in the innovation process.

When it comes to facilitating as realistic use situations as possible two different approaches can be observed in relation to Living Labs. In the first approach, environments for test and evaluation of products or services are created in ways that are similar to the real world (Markopoulos & Rauterberg 2000), while in the second approach products and services are tested and evaluated in users' real world environments (Schumacher & Niitamo 2008).

Another important aspect related to the principle of realism, but not specifically addressed by the principle, is the fact that different stakeholders face different realities. This means that what is important and motivating for one stakeholder, is not necessarily important to another stakeholder. For example, as a researcher, the reality can be focused on producing scientific results, while SMEs' reality can be to earn money by developing a new IT system. Different perspectives and views on the reality are also often mentioned reasons for why it is crucial to involve users as well as many different stakeholders in the development process. The reality aspect is also considered by focusing on involving real users, not using personas or other user representative theories.

Value

The notion of value and value creation in a Living Lab concerns several different aspects such as economical value, business value and consumer/user value. Economical value is highly tangible and can be viewed from different stakeholder perspectives. Living Lab activities or outcomes in the shape of innovations can often be transformed into economical value. Therefore these activities or outcomes can be assessed and evaluated from an economical value perspective.

Business value is a somewhat more intangible term that includes all forms of value that determine the health and well-being of a firm in the long-run. Business value expands the concept of economical value to include other forms of value such as e.g. employee value, customer value, supplier value, managerial value and societal value. Business value also often embraces intangible assets not necessarily attributable to any stakeholder group such as intellectual capital and a firm's business model.

There is a growing recognition that providing superior value for users is a key aspect for business success (Boztepe, 2007). One way to mitigate competition and open up entirely new markets is by focusing on creating advances in customer value (Kim & Mauborgne 2005). One key attribute that distinguishes breakthrough products from their closest followers, is according to Cagan and Vogel (2002), the significant value they provide for users.

According to Kuusisto (2008) the concept of value adding services or products imply that value is contained in the product or the service. The value is created and offered by the producer. Another perspective is the value-in use concept that focuses on the experience perceived by a user interacting with products or services in use situations. This concept implies that the customer is always a co-creator of the value. According to this concept, the customers experience and perception are essential to be able to determinate user value (Kuusisto, 2008).

Consumer value can also be defined in terms of the monetary sacrifice people are willing to make for a product. The primary focus here is on the point of exchange where money is seen as an index of value. According to this perspective, the assumption is that at the moment of purchase, the consumer makes a calculation and evaluation of what is given (value) in respect to what is taken in terms of money (Boztepe, 2007). Consumer value and consumer needs are also important aspects of adoption and diffusion theory.

Based on our experience, a Living Lab has the opportunity to create value based on all aspects of the value term. However, a Living Lab might also provide insights about how users perceive value. These insights can guide the innovation process to be able to deliver innovations that are perceived as valuable from both an economical, business, and a consumer perspective.

Sustainability

Sustainability refers both to the viability of a Living Lab and to its responsibility to the wider community in which it operates. Focusing on the viability of the Living Lab highlights aspects such as continuous learning and development over time. Here, the research component of each Lab plays a vital role in transforming the everyday knowledge generation into models, methods and theories. Other important aspects related to the sustainability of a Living Lab is the partnership and its related networks since good cross-border collaboration, which strengthens creativity and innovation, builds on trust, and this takes time to build up. In order to succeed with new innovations, it is important to inspire usage, meet personal desires, and fit and contribute to societal and social needs.

However, in line with the general sustainability and environmental trends in society it is of equal importance that Living Labs also take responsibility of its environmental, social, and economic effects.

Based on our experience, but also judging by the overall position of existing Living Labs we argue that there is a need to develop methods that help labs to take care of the learning generated and to transform this learning into scientifically sound models and methods. When it comes to the partnership and its related networks different Living Labs have different constellations, often with a weight on either public or private organizations. Here, it is important to learn more about how this affects the development and viability of a Living Lab.

3 Summary

In this paper we have argued for five key components and five key principles of Living Labs based on our experiences from over 30 research projects within two Swedish Living Labs. As the Living Lab concept by nature is multidisciplinary we have based our descriptions of the key principles on literature from several different fields. Furthermore, as there is no coherent definition of Living Labs available, we have also proposed a definition of Living Labs, after careful reviewing of existing definitions. In our definition we argue that a Living Lab is both an innovation milieu and an approach for innovation. Our definition is therefore as follows: *A Living Lab is a user-centric innovation milieu built on every-day practice and research, with an approach that facilitates user influence in open and distributed innovation processes engaging all relevant partners in real-life contexts, aiming to create sustainable values*.

The five key components of a Living Lab milieu are:

- ICT & Infrastructure
- Management
- Partners & Users
- Research
- Approach

The five principles for a Living Lab approach are:

- Openness
- Influence
- Realism
- Value
- Sustainability

Comparing Living Lab with the Lead user and Crowdsourcing concepts, which are well-known approaches to user involvement in innovation processes, reveals some differences, which are presented in table 2.

Table 2 Living Lab compared to the lead user and crowdsourcing concepts

Living Lab	Lead user	Crowdsourcing
Companies outsource the innovation process to the Living Lab, but participate in the process	Company driven innovation process	Company driven innovation process
Both an innovation milieu and an approach to innovation	An approach to innovation	An approach to innovation
Face-to-face and IT-based approach		IT-based approach
Support the whole innovation process	Support parts of or the whole innovation process	Support parts of the innovation process
R&D and independent researchers	R&D	No research

Our contribution to the field of open innovation is an illustration of a new concept, Living Lab, which combines an innovation milieu with a user-centered approach to innovation.

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