
Innovation from user experience in Living Labs: revisiting the ‘innovation factory’-concept with a panel-based and user-centered approach

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Abstract: This paper focuses on the problem of facilitating sustainable innovation practices with a user-centered approach. We do so by revisiting the knowledge-brokering cycle and Hargadon and Sutton’s ideas on building an ‘innovation factory’ within the light of current Living Lab-practices. Based on theoretical as well as practical evidence from a case study analysis of the LeYLab-Living Lab, it is argued that Living Labs with a panel-based approach can act as innovation intermediaries where innovation takes shape through actual user experience in real-life environments, facilitating all four stages within the knowledge-brokering cycle. This finding is also in line with the recently emerging Quadruple Helix-model for innovation, stressing the crucial role of the end-user as a stakeholder throughout the whole innovation process.

Keywords: Living Labs, user-centric innovation, knowledge-brokering cycle, user experience, idea generation

1 Introduction

Living Labs are put forward as an institution to overcome the so-called ‘European Paradox’ or the gap between research leadership and (commercial success of) innovation (Almirall & Wareham, 2011). However, Ståhlbröst & Bergvall-Kåreborn (2008) see Living Labs as a rather new research area with only a limited amount of supporting theories for understanding this concept. This lack of supporting theories, or rather the lack of agreement regarding the supporting theories (Eriksson et al., 2005; Schaffers & Kulkki, 2007) have induced on the one hand a proliferation of papers and articles on Living Labs and on the other hand a wide variety of approaches and projects carried out under the Living Labs-umbrella (Shamsi, 2008; Wilson et al., 2008).

Within this paper, we will aid to the conceptualization of Living Labs by revisiting the knowledge-brokering cycle of Hargadon & Sutton (2000). This cycle consists of four distinct elements: 1) capturing good ideas, 2) keeping ideas alive, 3) imagining new uses for old ideas and 4) putting promising concepts to the test. These elements can be put into practice in ‘innovation factories’ by relying on so-called knowledge brokers or innovation intermediaries.

By means of a case study of the LeYLab-Living Lab, we will demonstrate that Living Labs can be seen as playing the role of innovation intermediaries for all companies and organizations involved in the Living Lab. Living Labs can thus be conceptualized as contemporary ‘innovation factories’ for all stakeholders that match with the thematic basis of the Living Lab that generate ideas and knowledge based on real-life user experience with the end-user as an essential stakeholder throughout the complete innovation process.

2 Definitions of the Living Lab-concept

The term ‘Living Lab’ was first used to describe a laboratory environment with all facilities of a regular home, optimized for multi-day or multi-week observational studies of single individuals and constructed to resemble a ‘real’ home as closely as possible (Intille et al., 2005). Volunteer research participants inhabit these ‘living laboratories’ where the routine activities and interactions of everyday home life can be observed, recorded for later analysis, and experimentally manipulated (Eriksson et al., 2005). This definition sees the Living Lab-concept merely as a **research facility** that tries to overcome the artificial lab-context and is referred to as the American vision on Living Labs (Schuurman et al., 2011). In Europe, the Living Lab-philosophy gained momentum through its support by EU-policy, as it is tightly linked to the ‘Strengthening innovation and investment in ICT research’-pillar of i2010, the EU policy framework for the information society and media (Peltomäki, 2008). Within this context, several international organizations representing several industrial ICT Living Lab-initiatives were founded of which the European Network of Living Labs (ENoLL) is the most well-known (cf. ENoLL, 2007).

However, the European Living Labs differ fundamentally from the American notion. Instead of studying the user in a laboratory constructed to re-create a home environment,

the user is studied in his or her everyday habitat. However, when studying the different set-ups and conceptualizations of Living Labs, the concept seems to be used in multiple ways.

In one sense, Living Labs are defined as **experimental platforms** where the user is studied within the context of everyday life (Niitamo et al., 2006). Feurstein et al. (2008) see Living Labs as an R&D **methodology** in which innovations are created and validated collaboratively in multi-contextual, empirical real-world environments. Frissen & van Lieshout (2004) see Living Labs as consciously constructed **social environments** in which the uncontrollable dynamics of everyday life are accepted as part of the innovation environment which enables designers and users to co-produce new products and services. Another definition focuses on Living Labs as an **eco-system** where users are subjected to a combination of research methodologies while they test new technologies that are still in development with the focus on accessing the ideas and knowledge of the users regarding the tested technology are being used within a Living Lab-setting (Eriksson et al., 2006). Research on user-oriented innovation models see Living Labs as an **innovation system** and closely related to the so-called quadruple helix-models (Arnkil et al., 2010). This is in line with the finding that although novel ideas are often born in individuals' minds, new ideas cannot appear without social practices and norms, in short the cultural environment (Santonen et al., 2011). Thus the source of new ideas and innovations is a dual process between an individual and a social environment, with the individual relying on inner resources (such as memory and intentions) and the social environment providing outer resources. As an innovation system, Living Labs incorporate both the individual input as well as the social environment through a multi-methodical and multi-stakeholder approach.

Summarizing, Living Labs differ from the more traditional views on innovation by incorporating the following two elements: *user involvement* from the early stages on and experimentation in *everyday context* (Mahr & Schuurman, 2011). Based on this observation, Almirall (2008) sees Living Labs as capable of providing structure to user participation. Other important elements in the context of Living Labs are the *multi-methodical* research approach and the *multi-stakeholder* aspect. Therefore, Almirall coins the term innovation arena, but also '**innovation intermediary**' to conceptualize Living Labs. Within this paper, we will further explore Living Labs in their role of innovation intermediary or knowledge broker.

3 The knowledge brokering cycle

Within the context of open innovation, ideas and knowledge are distributed amongst a wide array of players and institutions (Chesbrough, 2003). In order to establish links and develop relationships between these producers of knowledge and/or ideas, a specific kind of intermediary evolved: the knowledge broker. These knowledge brokers are organizations or persons that provide knowledge sources, linkages or even knowledge itself to the organizations, companies and institutions in its network (Hargadon, 1998). The concept of 'knowledge brokering' is conceptualized and operationalized differently in various sectors and settings, but the facilitation of knowledge sharing and exchanging among various stakeholders appears to be the key feature. Knowledge brokers are also closely related to the so-called 'innovation intermediaries' (Verona et al., 2006).

Hargadon & Sutton (2000) started from the idea of knowledge brokering to develop their idea known as the ‘knowledge brokering cycle’. A large study of businesses that innovated almost constantly led to the observation that the best innovators systematically use old ideas as the raw material for new ideas and concepts, thus serving as intermediaries between otherwise disconnected pools of ideas. They use their in-between position to spot old ideas and re-use them in new places, new ways and new combinations. Some companies from the study were able to make this leap from old ideas to new innovative concepts again and again. This approach is called the knowledge brokering cycle, consisting of four different phases.

Capturing good ideas. Knowledge brokers act as scavengers, looking for promising ideas. These ideas originate from a wide variety of places and act as the primary raw material. This way, knowledge brokers sometimes create massive collections of ideas where some will lead to innovations, while others will not.

Keeping ideas alive. Playing with ideas, discussing them and using them is necessary to keep ideas alive. This follows from the simple observation that ideas cannot be used if they are forgotten. To remain useful, ideas must be passed around, toyed with or even systematically re-evaluated. Effective brokers keep ideas alive by spreading information on who knows what within the organization.

Imagining new uses for old ideas. At this phase, ideas are turned into new concepts by putting them into new contexts. This is sometimes facilitated by creating physical layouts or co-working spaces that allow or even force people to interact with each other.

Putting promising concepts to the test. Testing shows whether an innovative concept has added value and commercial potential. Promising concepts are turned into real services, products, processes or business models. Even when the idea turns out to be a complete failure, this failure teaches the idea brokers valuable lessons.

Hargadon & Sutton see this knowledge brokering cycle as a system of sustaining innovation that can be replicated and implemented within virtually every firm or organization. However, they see this process mainly as taking place within one single company or organization. Within the next paragraphs, we will explore the concept of the knowledge brokering cycle in the context of Living Labs by means of a case study.

3 Research design

Case study research excels at bringing us to an understanding of a complex issue or object and can extend experience or add strength to what is already known through previous research. Case studies emphasize detailed contextual analysis of a limited number of events or conditions and their relationships. Researchers have used the case study research method for many years across a variety of disciplines. Social scientists in particular have made wide use of this qualitative research method to examine contemporary real-life situations and provide the basis for the application of ideas and extension of methods. 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 (Yin, 1984, p. 23).

In this paper we employ an exploratory case study analysis to explore the Living Labs as innovation intermediaries within the framework of the knowledge brokering cycle. Seen

the novelty of Living Lab theories and the lack of a clear and unified definition, this research approach seems the most appropriate. This exploratory method is especially suited for investigating new and poorly understood processes (Eisenhardt, 1989). Moreover, within this method it is possible to analyse multiple levels within a single case study (Yin, 1984).

4 Case study: LeYLab Living Lab

LeYLab is a Living Lab situated in Flanders, Belgium which offers fibre internet access to a panel of households and organizations. The 'L' is representing Light, the 'Y' representing You and 'LeY' resembling 'Leie', the river situated in the Living Lab-area, hence the name 'LeYLab'. This Living Lab was set up in September 2010 following the public call in Flanders for Living Labs with 'Converged Broadband Access networks' as central theme. The Living Lab was operational by July 2011 and its fibre network is located in two geographical restricted areas (city areas Buda and Overleie) in the City of Kortrijk. By building a Living Lab environment for Next Generation Access (NGA), based upon fibre, testing innovative applications and services is made possible. Fibre offers unprecedented test facilities, in terms of bandwidth and quality of service and will stimulate the ICT sector to develop innovative applications. Therefore, the goal of LeYLab is to stimulate innovation and to measure the relevance of new services for the personal lifestyle and living environment of the test users.

The **consortium** of LeYLab consists of 11 industrial partners (Alcatel-Lucent, Belgacom, Androme, Comsof, Focus WTV, In-HAM vzw, OCMW Kortrijk, City Kortrijk, Televic, U-Sentric & Videohouse) and the research partner IBBT-iLab.o. The Living Lab focuses on three thematic domains: e-care, multimedia and gaming. The fibre internet connection functions as a facilitator for the testing of innovative services and products.

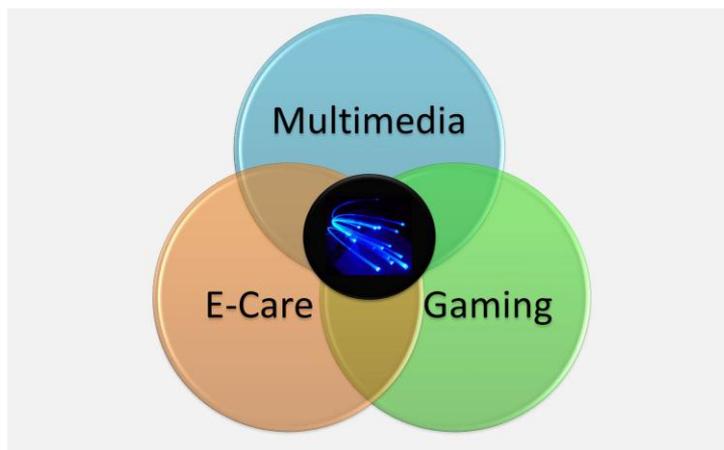


Figure 1 Thematic domains of LeYLab.

All partners are either involved in the infrastructure related aspects of building a NGA network or in the development of innovative applications. Belgacom, the largest telecom provider in Belgium, deploys the fibre infrastructure and supervises the network. Alcatel-

Lucent provides the necessary equipment for the in-home usage of the fibre connection (modem, router,...) and is responsible for the monitoring of the network (logging) and for the integration of all services and devices within the network. LeYLab is based upon an Open Service Platform using industry-recognized standards. Through this, third parties can be easily integrated and get access to the test panel at a minimum cost, so that the innovator can focus on the application. Panel management, a SPOC (single point of communication) helpdesk and all research activities are coordinated and carried out by IBBT – iLab.o. LeYLab is also a member of ENoLL and has performed several ad-hoc projects in the domain of Multimedia, mostly testing new innovative applications in gaming and sharing or downloading multimedia content.

The region where the fibre network was rolled out was chosen based on a geo-marketing study carried out by Belgacom. This study indicated that the inhabitants within the city areas Buda and Overleie were the most diverse in terms of socio-demographic characteristics, thus offering the best chance for a diverse user panel. In January 2011, a large communication and recruitment action was set up in order to motivate people living in the selected areas to participate in the Living Lab. This consisted of various info moments and mailings. In order to participate, an intake-survey had to be filled out per household containing various questions regarding the three core themes of the Living Lab and allowed a first profiling and segmentation of the participating households. Subsequently, a site survey was carried out in order to prepare the installation. Eventually, 115 addresses were connected to the fibre network. Besides 98 households there are also 17 local non-private connections (e.g. cultural organizations, one school, companies,...). In order to facilitate testing of different services for different devices, the consortium decided to provide some of the connected homes with extra devices besides the fibre connection. The choice was based on the data from the intake survey: 43 households were provided with a Samsung Tablet and 36 with a mini-pc that was connected with a flatscreen in the living room.

The panel represents a broad and diverse sample in terms of socio-demographic variables and in terms of ICT-skills and knowledge. Research data from one of the profiling surveys has indicated that some panel members can be considered **Lead Users** in the area of internet-applications, whereas other panel members are clearly **ICT-laggards**, as two households did not even have an internet connection before the LeYLab-Living Lab. The fact that all participants are living in the same area stimulates the spontaneous community building (e.g. people helping each other when they have problems with their tablet or mini-pc). Occasionally, a social event (e.g. Buda Libre Event) is organized to stimulate this community feeling, involving also other inhabitants of Kortrijk, entrepreneurs or politicians. Finally, local, cultural organizations and the city of Kortrijk also use the fibre network for content sharing and pilot projects involving city development.

5 Results

We will now illustrate the added value of a Living Lab in the light of the knowledge brokering cycle by means of the LeYLab-case study. We will suggest the opportunities for each of the phases in the cycle.

Capturing good ideas. As knowledge brokers assemble information and ideas from a wide variety of places, a lot of interesting data and ideas can be gathered within a Living Lab-setting. For LeYLab, this includes all research data from e.g. surveys, diary studies, focus groups or observational studies, but also the objective logfiles of the activity of the panel members on the fibre network. This research data can lead to the identification of innovative or emergent habits and practices that might spark novel ideas, but within all research that is carried out, a lot of ideas from the panel members themselves is captured. The sources that possess the knowledge and the ideas are the panel members themselves and the researchers gathering and analyzing data. For instance, analysis of the logging data indicated that some panel members used the fibre network much more often for (illegal) file sharing than what they mentioned in surveys. Brainstorming sessions with panel members and cultural stakeholders led to the idea of a shared platform for the cultural players in the region where end-users could easily access all kinds of cultural content and data and where cultural players could easily manage and upload their content. Summarizing, by following a user panel over a longer period, a lot of ideas can be captured, from users themselves as well as from analyzing the user and usage data, and this information and these ideas can be spread amongst other stakeholders, within or even beyond the LeYLab-consortium.

Keeping ideas alive. The gathered data and ideas within the LeYLab-Living Lab are kept alive sharing the research results with the partners within the Living Lab. During the monthly meetings with all consortium members, this data and these ideas are discussed. Through academic and industry presentations, the ideas and data are also disseminated externally. Moreover, the availability of a user panel allows to keep and breed ideas within a real-life community. As the LeYLab-panel members live in the same region, this stimulates social interaction between them regarding products, services and technologies within the Living Lab. E.g. from the first profiling survey it appeared that the panel members were not fully satisfied with the usability of the city website. This need was captured from the LeYLab-panel and at a social event where besides panel members and consortium members external parties were also present, the idea took shape to develop a mobile application allowing for an easy search within all documents and information present on the city website.

Imagining new uses for old ideas. Through the internal (within the consortium) and external dissemination of research results and users' ideas, possibilities and opportunities can arise. The LeYLab-consortium consists of companies and organizations with different backgrounds and interests, which facilitates the construction of an ecosystem allowing to translate certain ideas or practices into new concepts. As all consortium members also have their own network, this ecosystem can also easily be constructed with external partners. However, the imagining new uses for old ideas is also automatically incorporated through the process of domestication that is facilitated through the Living Lab-setting. The LeYLab-panel members can use the services, technologies and devices in their natural everyday habitat for a prolonged period of time which allows them to domesticate these services, technologies and devices. Within this process of integration the end-users themselves can imagine and display new or unexpected uses and practices. This is not only the case for the new products or services that are made available to the panel, but by closely surveying and monitoring their activity, new uses and practices can

be detected for ‘old’ or already well known products or services. An example of this can be found within a co-creation session for a second screen application that one of the partners (WTV, a regional TV station) wanted to develop. The developer had created a first paper mockup of the application, but within the co-creation session, a selection of panel members totally changed the features and appearance of this application. Based on their contextual experience they had with tablet applications because they received one as a LeYLab-panel member, they provided novel and innovative suggestions. At the end of the co-creation session, the initial paper mockup had taken a totally different shape. In short, through actual usage and practice, analyzed over a prolonged time period, (re)negotiation and in-depth evaluation of (old) ideas and concepts is being in LeYLab.

Putting promising concepts to the test.

A Living Lab-setting is perfectly suited to quickly put promising concepts to the test. The readily-available panel with in-depth profiles allows for quick testing and evaluation of concepts. This testing can take the form of a proxy technology assessment (PTA) or can consist of making available a prototype or beta-version for a selected set of end-users. This kind of field trial within a Living Lab-setting allows for spontaneous and reliable feedback on the concept, based on real experience with the concept in an everyday setting. These field trials facilitate the capturing of all kinds of research and usage data that can be used as input for again new ideas. Also, by actually using a new product or service, end-users extend their imaginative and innovative capacities which can trigger idea-generation on their own (which was also the case in the second screen co-creation session, cf. supra).

Table 1 Living Lab-contribution in terms of the knowledge brokering cycle

Knowledge brokering cycle	Living Lab-contribution
Capturing good ideas	- data-gathering through research and logging - idea-generation by panel-members, consortium-members and external parties
Keeping ideas alive	- dissemination of research and ideas - ‘live’ community
Imagining new uses for old ideas	- easy construction of ecosystem - process of domestication
Putting promising concepts to the test	- availability of technological infrastructure - availability of a real-life test panel

6 Conclusion

Within this paper, we have presented a state-of-the-art regarding the different conceptual definition of Living Labs. We concluded that Living Labs are mainly defined by user involvement from the early stages on, experimentation in an everyday context, a multi-methodical research approach and a strong multi-stakeholder character. It was also

suggested that Living Labs could be seen as innovation intermediaries of knowledge brokers. This finding triggered us to revisit the classic 'knowledge brokering cycle' through a case study-analysis on a recent Living Lab-initiative in Flanders. This case study revealed that a panel-based Living Lab-approach can be seen as playing the role of an innovation intermediary for all companies and organizations involved in the Living Lab and for all external parties getting in contact with the Living Lab. We therefore conclude that Living Labs can be conceptualized as contemporary 'innovation factories' that generate ideas and knowledge based on real-life user experience for all stakeholders that match with the thematic basis of the Living Lab. Within this process, the end-user is considered an essential stakeholder, whereas in the classic definition of an 'innovation factory' the end-user only plays a role in the final phase of the knowledge brokering cycle, the testing-phase. These observations are also in line with the recently emerging notion of the 'quadruple helix'-model of innovation. User experience is thus fundamental for innovation fostering in Living Lab-settings.

Future research might include other Living Lab-settings being reviewed in the light of the knowledge brokering cycle. It would also be interesting to try to measure the added value of a panel-based Living Lab-approach over the classical intra-company innovation factory-approach.

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