Knowledge exchange for innovation development in open innovation systems: Living Labs as innovation intermediaries & knowledge brokers aligning user & stakeholder input

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Keywords

Open innovation, Knowledge flows, Living Labs, Innovation ecosystems

Abstract

In nowadays knowledge economy, no more general 'best practice' innovation management exists. However, in Europe there appears to be a gap between exploration and exploitation of knowledge, a phenomenon referred to as the 'European paradox'. One of the solutions put forward by the European Commission to overcome this paradox are the so-called Living Labs. To stimulate this innovation approach, the European Network of Living Labs was erected in 2006. However, to this day, Living Labs have not been able to fully realize their potential. A more fine grained conceptualization and a better understanding of the mechanisms of Living Labs remain a task in progress. Therefore, within this paper, we investigate the potential of Living Labs as open innovation systems that foster different knowledge transfers amongst the actors participating in them. By means of an in-depth case study research we explore a variety of hypotheses abstracted from the open innovation literature on knowledge transfers and other variables influencing exchange and collaboration in open innovation systems. We conclude that given certain criteria are met, Living Labs can be a solution for sustainable innovation development.

1 Introduction

Ever since the industrial revolution started near the end of the 18th century, the dominant innovation logic aimed at vertical integration within the boundaries of a firm or company. Only near the end of the 20th century, this dominant view was challenged in favor of a more distributed view on innovation. This shift in the dominant mode of innovation, from vertically integrated innovation towards a more distributed mode of innovation, has forced companies to alter both their research and development processes and their approach to innovation management. Instead of focusing on hiring people with all relevant skills and knowledge, and investing heavily in internal research and development capacities, companies had to actively look outside for knowledge and technology to complement internal assets. This shift in the dominant mode of innovation not only required companies to adapt by developing or acquiring different skills and abilities, it also encouraged a growing body of research into the nature and occurrence of distributed innovation processes. Basically, there are two distinct modes of distributed innovation differing in terms of the nature of the external input. First, firms (innovators) can rely on external actors/parties to supply knowledge that serves as an input to creating their own innovations. Second, firms can also rely on external actors/parties to supply innovations that are used or commercialized by them. There are two major research streams linked to the phenomenon of distributed innovation that study both modes from a different perspective (Bogers & West, 2012). The open innovation paradigm takes the firm's perspective and examines the financial benefits of engaging in distributed innovation (West and Bogers, 2013). In contrast, the user innovation stream looks at distributed innovation processes from the perspective of the user (von Hippel, 2009). In this stream, the focus of the analysis lies mainly on the utility gains the innovation brings to this user. A specific situation where these two perspectives come together is the case of user entrepreneurs, where users innovate and decide to commercialize their innovation themselves (Shah and Tripsas, 2007).

In the context of distributed innovation, two concepts are also often mentioned. Cumulative innovation is a specific form of innovation where business and/or individual users incrementally improve upon the work of producers and other users (Murray & O'Mahony, 2007). This form of innovation often

takes place in the context of a radical innovation that is being refined to become useful (Nuvolari, 2004). A similar, but broader concept is the act of so-called co-creation. The innovation process is no longer seen from a single-inventor perspective or a serial-single-inventor perspective (cumulative innovation) but considers innovation as the collaborative development of two or more stakeholders. This process involves knowledge inflows and outflows between complementary partners, including horizontal and vertical alliances (Bogers et al., 2010). Beyond creating product innovation, co-creation can also be a way to create value more generally (Prahalad & Ramaswamy, 2003; Vargo & Lusch, 2004). Within the context of distributed innovation, co-creation can be seen as a bridge between the open and user innovation perspectives, as it indicates shared value creation between users and firms, which makes co-creation a strategy for firms to tap into user innovativeness and extend their own knowledge base.

Within this distributed view on innovation processes, the creation and transformation of knowledge from different sources into innovation is a crucial process. However, on a European level, there is an apparent strength in generating knowledge, while the translation into actual successful innovations is lagging behind. This is referred to as the 'European Paradox' (http://en.wikipedia.org/wiki/European_paradox) or the gap between research leadership and the commercial success of innovation. Almirall and Wareham (2011) rephrased this 'European Paradox' in terms of open innovation concepts and stated that Europe scores high in terms of research (= exploration), but underperforms in terms of market success (= exploitation). In order to overcome this paradox, several initiatives were kickstarted on the European policy level, such as the promotion and support of industry-university links and relationships (Perkmann and Walsh, 2007). A specific case of industry-university relationships received considerable support from Europe: Living Labs. In the 1990's the concept of Living Labs already appeared in academic discussions, but the policy support by the European Commission in 2006, stimulating projects to advance, coordinate and promote a common European innovation system based on Living Labs, provided a boost to the concept (Dutilleul, Birrer & Mensink, 2011). In order to stimulate Living Lab research, several international organizations representing industrial ICT living lab initiatives were founded, with the European

Network of Living Labs (ENoLL) being the most influential. To date, more than 300 Living Labs, mainly in Europe but also in the rest of the world, are linked to the ENoLL (European Commission, 2013b). Although the Living Labs concept has been given a wide variety of interpretations and has led to a wide diversity of initiatives, it is been considered a given that Living Labs rely on co-creation as a central process for value creation (Levén and Holmström, 2008). Therefore, we propose Living Labs as a form of distributed innovation that drives on co-creation with a central role for users. The characteristics of Living Labs and the nature of Living Lab innovation processes enable to study this specific form of co-creation from both the angle of open innovation and of user innovation. This is in line with Almirall & Wareham (2011) who state that "Living Labs are semi-partitioned spaces in the form of innovation arenas integrated in real-life environments but separated by means of an innovation project structure that cultivate user-led insights" and "Living Labs are fundamentally infrastructures that surface tacit, experiential and domain-based knowledge such that it can be further codified and communicated". This suggests that Living Labs might be able to bridge the gap, identified by Bogers & West (2012), between open and user innovation by facilitating co-creation of innovation through connecting the innovative capacity of users (user innovation) with the innovative capacities of public and private stakeholders participating in Living Lab projects.

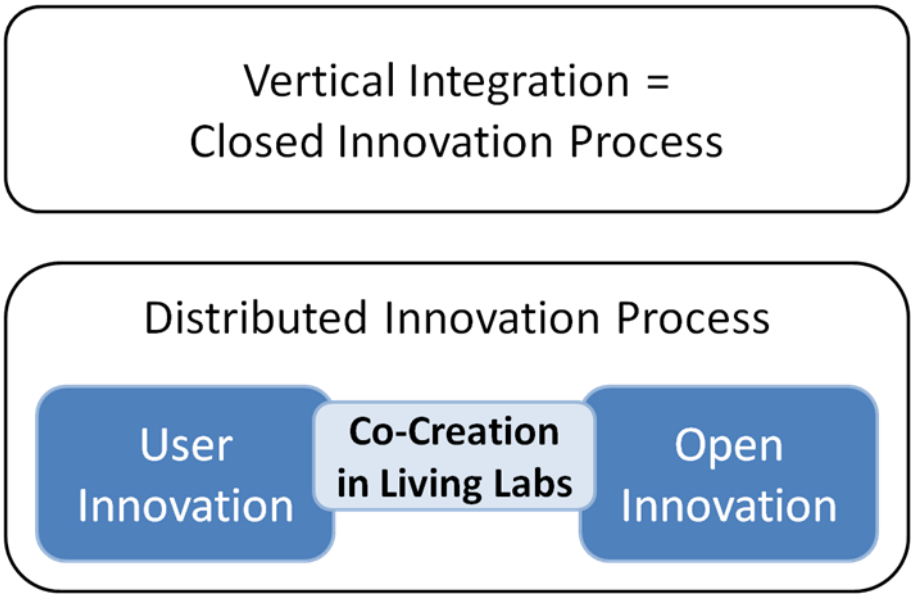

Fig. 1. Positioning Living Labs amongst innovation paradigms

Within this paper, we will further explore this position of Living Labs as innovation intermediaries facilitating innovation by gathering user and stakeholder input and aligning the goals and needs of the actors involved. We will first explore the

2 Evolution of European Living Labs

When discussing the emergence of the current Living Labs-movement, we have to dedicate attention to the European Network of Living Labs (ENoLL), headquartered in Brussels, which played an important catalyzing role. The ENoLL is a community of Living Labs that was born in November 2006 under the guidance of the Finnish European Presidency and was intended to give rise to "a paradigm shift for jobs, growth and competitiveness" (Prime Minister's Office, 2006a). Within the so-called Helsinki Manifesto (2006) ENoLL was described as a platform for knowledge sharing and collaboration to foster common methodologies and tools across Europe that support, stimulate and accelerate co-creative innovation processes, relying on users involvement. The overall aim of the network is to support the creation of a dynamic innovation system throughout Europe. Therefore, the EU Commission allocated 40 Million of Euros, in order to promote the development of the ENoLL (Prime Minister's Office, 2006b). Essentially, the ENoLL tries to foster "co-creative, human-centric and user-driven research, development and innovation in order to better cater for people's needs" (ENoLL, 2013). The start-up of ENoLL was part of the 6th and 7th Frameworks, overseen by the Directorate-General Information Society and Media and the Directorate-General for Research. Therefore, the European commission was and still is a central actor in the network.

The following services are offered to its members: the use of the official ENoLL label with publication on the website, the use of the official network contact point in Brussels for all inquiries, communication and promotion services, project development services to initiate and apply for participation in collaborative projects, brokering services between other Living Labs or other interesting parties, policy and governance services, and learning and educational services through ENoLL workshops and conferences. Note that most services deal with networking between Living Labs in order to exchange experiences and to facilitate the start-up of new projects. In the light of our

historical overview of predecessors, the ENoLL is the kind of network that was advocated for in the 1980s by the people involved in the social experiments. The network has taken the legal entity of an association and adopts an open structure, with a core of fee-paying members and partners supplemented by more informal networks of policy-makers and individual users. The association consists of effective members, adherent members and associated members. Effective members (currently 19) are legal entities that represent a Living Lab, that have passed the selection process and that pay the annual membership fee. Associated members are organizations involved in the activities of the association, that pay the annual membership, but that have not passed the selection process. Adherent members are organizations that represent a Living Lab, that that have passed the selection process, but that do not pay the annual membership fee and thus have no voting rights. The association is managed by a Council appointed by the General Assembly. Only the effective members can vote at the General Assembly, while each type of member can take part and be a candidate of the Council with certain restrictions. The General Assembly has all powers allowing the realization of the objects as well as of the activities of the association. All members, effective, associated and adherent are invited to attend the Assembly. Over the past few years, the network has constantly grown in so-called waves, with up to now seven waves taking place and a total of 353 LLs being accepted (ENoLL, 2013). Originally, the ENoLL consisted only of European Living Labs that were admitted to the network after a benchmarking exercise, but nowadays, next to a variety of European countries (such as Belgium, Finland, Germany, Italy, Spain and UK) other countries, as Brazil, Canada, the United States and Australia are also involved in the network. Through this international context, the ENoLL facilitates the testing of products and services in different countries with their own cultural environments.

In the context of innovation, this yields additional opportunities as previous research has proven that cultural differences often influence the take-off or acceptance of innovations (Steenkamp, Hofstede & Wedel, 1999). Følstad (2008) makes the observation that the opportunity to conduct real-world validation studies of testbed applications seems to be an important motivation for many of the Living Labs belonging to ENoLL, something which is also apparent in the work of Ballon et al. (2007).

However, exactly this very heterogeneous market in Europe with local differences in culture and consumer behavior, and the lack of cooperation between large resource intensive companies and small entrepreneurial companies, which holds the potential for synergies, have caused the so-called "European Paradox" (Almirall & Wareham, 2011). This means that Europe is strong in terms of knowledge (e.g. patents), but underperforms when it comes to transforming this knowledge into market success (profit and innovations). Explained in concepts from the Open Innovation literature, Europe scores high in terms of exploration, but fails to translate this to actual exploitation. In a recent publication, the European Commission (2013b) noted that there is a low amount of interaction between companies, and a common physical or virtual place to meet innovation partners is lacking. Especially small companies face barriers to innovate, as compared to e.g. the US, business angels and venture capitalism are less prevalent in Europe, concerns about intellectual property (IP) protection remain, and a common culture and identity that could counterbalance these barriers is not in place (European Commission, 2013b). This holds somewhat of a paradox. Because of the "European Paradox", the European Commission has put forwards the need for innovation systems that overcome the mentioned barriers to innovation for European companies and that create a bridge between knowledge and market, and see Living Labs as such innovation systems (European Commission, 2013b). However, as Europe already starting supporting Living Labs in 2006, currently more than 300 Living Labs exist, mainly in Europe but also worldwide (European Commission, 2013b). Previous research has indicated that this has also led to a large variety of initiatives carrying the Living Labs-label in order to get European funding and applying to become a member of ENoLL. Remember that the funding for Living Lab-initiatives and for ENoLL were intended to solve the European Paradox. However, after almost eight years, this European Paradox still seems to exist, despite the 353 benchmarked Living Labs. One of the main hurdles seems to be the project-based character of the funding, which makes it difficult for Living Labs to be sustainable and fosters the need for new business models which enable more long-term initiatives (Guzman et al., 2008). Although Living Labs are seen as having the potential to overcome the issues and frustrations linked to project-based funding (Pitse-Boshomane et al., 2008), some Living Labs are explicitly short-term. Ståhlbröst (2012) names these initiatives 'living lab as a project' and defines them as Living Labs that exist during a project's

lifetime to support the innovation process in that project and that close when the project ends. This raises some issues with regards to the ENoLL and the Living Labs that are member of this network. First, the number of ENoLL Living Labs, currently 353, has always been increasing since ENoLL's inception. Within the literature and sources of ENoLL there is no trace of this kind of 'stopped' or 'dead' Living Labs. However, a high-level analysis of the online traces of the ENoLL Living Labs revealed that out of the 353 Living Labs, only 333 are mentioned on the ENoLL website. Moreover, when looking at the dedicated websites of these Living Labs, 141 (42,3%) seemed to be inactive. Therefore, there is an urgent need to revise and review the number of Living Labs and to filter out 'dead' initiatives. Second, there is also a remarkable trend when we analyze the growth of ENoLL during the seven waves. If we plot the number of Living Labs entering ENoLL in each wave, we come to the following graphic:

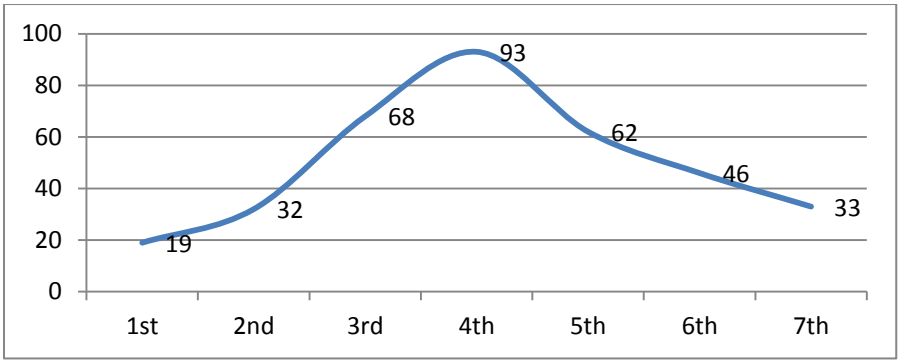

Fig. 2. Evolution of ENoLL-growth

The first wave of Living Labs in 2006 yielded the first 19 Living Labs, which formed the core of the network. Since then, every year a new wave was launched, calling for applications to initiatives to enter the network. The second wave in 2007 resulted in 32 new Living Labs being added to the network, the third wave this number was more than doubled with 68 new Living Labs admitted and in 2009, an all-time high of 93 Living Labs joined ENoLL after passing the review process. However, from 2011 onwards, the number of new Living Labs started to drop. The fifth wave resulted in 62 Living Labs, the sixth wave in 2012 in 46 entries and only very recently, only 25 new Living Labs entered the network. This seems like an indication that the Living Lab-concept has passed its *peak of inflated expectations*, when talking in terms of Gartner's hype cycle, and is now entering the through

of disillusionment (Fenn & Linden, 2000). Crossing this 'chasm' towards the so-called slope of enlightenment and plateau of productivity is currently a major challenge for Living Labs, and this ironically shows a lot of parallels with the more general challenge for innovations in today's ICT environment (Moore, 1999; De Marez, 2006), as Living Labs can be regarded as a means for innovations to overcome this chasm.

This slowdown in growth of the network and the large number of stopped or 'dead' initiatives might also be linked to an evolution in the definition and conceptualization of Living Labs during the last ten years. In 2004, Frissen & van Lieshout defined 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. This pre-ENoLL definition focuses on user involvement and on the everyday context as an important divergence from more traditional views on innovation. A second definition from Eriksson et al. (2006) and Niitamo et al. (2006) sees Living Labs as ecosystems fostering user-centered innovation through experimental platforms where the users are studied in their everyday habitat, and this by means of quantitative as well as qualitative research methods with the focus on accessing the ideas and knowledge of these users. The user-centric aspect is once again very dominant, as well as the everyday habitat, but the co-creative aspect is not explicitly mentioned here. A multi-methodical research approach is also put forward as inherent in Living Lab-practice. Ståhlbröst & Bergvall-Kåreborn (2008) give a quite similar definition, but again mention co-creation explicitly as they state that Living Labs are a means to gain access to the ideas, experiences, and knowledge that users possess, built upon co-operation with users to support creativity, so an efficient interaction with a larger population of people should be facilitated. They place Living Labs within a strong user-centric approach but do not stress the everyday habitat. It was not until 2008 with Feurstein et al. that Living Labs were seen as a systemic innovation approach in which all stakeholders in a product, service or application participate directly in the development. Living Labs are thus seen as collaborations of public-private-civic partnerships in which stakeholders co-create new products, services, businesses and technologies in real life environments and virtual networks in multi-contextual spheres. In this definition the end-user

is only one of the stakeholders involved. Turkama (2010) explicitly distinguishes the underlying principles of Living Labs as opposed to those from the closed innovation model and user driven Open Innovation. Within these brief overview of definitions we can see an evolution from Living Labs as user centered and user driven approaches towards a more fully eco-system driven approach, with attention for all (possible) stakeholders in the innovation process (cf. also Schuurman et al., 2012b).

Based on an empirical investigation of multiple Living Labs, Leminen et al. (2012) propose four different Living Lab actors based on their role: utilizers, enablers, providers and users.

- ***Utilizers*** aim to develop their businesses within the Living lab ecosystem, mostly through short-term Living Lab cases. Their focus is on developing and testing their new products and services. These utilizers use Living Labs as a strategic tool to collect data on test-users of their products or services and collaborate with all stakeholders in the Living Lab ecosystem, including the end-users. These actors drive short-term Living Lab projects and can be regarded as short-term, ad hoc 'consumers or partners of the Living Lab'.

- ***Enablers*** can be various public sector actors, non-governmental organizations, or financiers, such as towns, municipalities, or development organizations. This actor provides (financial) resources or policy support in order to start-up and maintain the Living Lab operations.

- ***Providers*** provide the other actors in the Living Lab with their product or service portfolio. They take care of the (material) infrastructure used for the Living Lab operations. Providers are mainly private companies that enter into Living Labs to co-develop new products, services, and solutions to their own business or industry needs, and focus more on long-term results. They attain these goals through their involvement in general Living Lab operations and (possibly) in the Living Lab cases, driven by utilizers.

- ***Users*** are the 'end-users' that are being involved in the Living Lab-operations and in the (short-term) Living Lab cases. In some Living Labs, existing user groups or user communities are involved, while in others the Living Lab operations themselves facilitate the formation of a Living Lab user community.

In the typology of Leminen et al. (2012) academic researchers are considered providers because they provide the necessary expertise on user research. Other research such as the triple and quadruple helix concepts, however, stresses the importance of universities as a distinct actor in the innovation ecosystem (Perkmann and Walsh, 2007; Etzkowitz, 2008; Arnkil et al., 2010; Cosgrave et al., 2013). Moreover, the contribution of academia is not limited to user research, as it can also include research on technical topics related to the focus of the Living Lab or policy and business researchers. Therefore, we distinguish ***researchers*** as a separate type of actor within the Living Lab anatomy.

Based on the various roles of the Living Lab actors and the central role of the infrastructure, we propose the following theoretical model of a Living Lab.

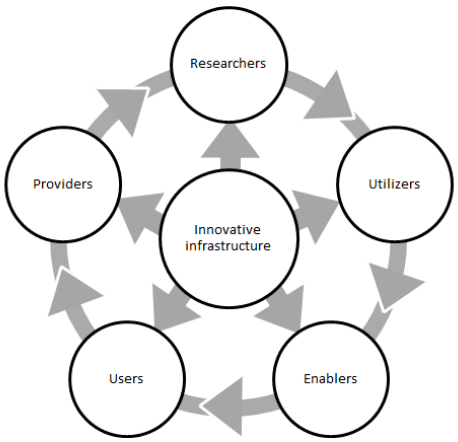

Fig. 3. The anatomy of a Living Lab

In this paper, we will empirically investigate the occurrence of these roles within concrete Living Lab projects and how knowledge flows are distributed between these actors. Next, we will give an overview of the theoretical basis of these knowledge flows from an open innovation perspective.

3 Knowledge transfers in open innovation ecosystems

Traditionally, innovation was viewed as an inherently closed process with most operations running inside the boundaries of the company and R&D processes taking place in secretive in-house laboratories. Company knowledge and technologies were protected and kept safe from external

influences. This view on innovation management can be characterized as ‘closed innovation’ or the ‘vertical integration model’ (Chandler, 1977). More recently, this closed, vertically integrated model has been challenged and replaced by a distributed view on innovation and innovation management (Bogers and West, 2012). The first acknowledgement of distributed innovation processes can be found in the seminal works of von Hippel (1976) who pointed out to the existence of user innovation. This eventually led to the so-called user innovation framework which investigates the circumstances under which users start innovating themselves and the characteristics these innovative users display (Sawhney and Prandelli, 2000; von Hippel, 2005).

A second major framework building further on the notion of distributed innovation is open innovation, which took shape in the beginning of the 00s. Chesbrough et al. (2005) defined open innovation as a non-linear innovation process with more co-operation between internal R&D departments and the outside world, and with companies benefiting from the synergies associated with this collaboration. Open innovation assumes that firms can and should use external ideas as well as internal ideas (Chesbrough, 2003). Factors that have favored the shift towards a more open innovation model include an increased job mobility (Cooper, 2001), the recognition of decentralized knowledge (Evans and Wolf, 2005) and shorter product life cycles (Van de Vrande et al., 2009).

From the perspective of a single firm, the usual level of analysis in open innovation research, the whole concept of open innovation is grounded on the premise that opening the internal innovation process of a firm yields extra value (Chesbrough et al., 2008). This openness is attained by enabling both inbound and outbound knowledge transfers: internally acquiring external knowledge (‘buying’) and externally exploiting internal knowledge assets (‘selling’), a phenomenon that is referred to as two sides of openness (Torkkeli et al., 2009) or the ‘coupled process’ of open innovation (Enkel et al., 2009). Besides (immaterial) knowledge, materialized knowledge in the form of technologies can also be the subject of inbound or outbound movements, processes that are referred to as ‘technology acquisition’ and ‘technology exploitation’ (Lichtenthaler, 2011). Knowledge and technology transfers are key processes that have been studied in open innovation literature.

Two main concepts used to classify open innovation practices are technology or knowledge exploitation versus exploration. Purposive outflows of knowledge, technology or **knowledge exploitation**, implies innovation activities to leverage existing technological capabilities outside the boundaries of the organization. Purposive inflows, which we will refer to as technology or **knowledge exploration**, relates to innovation activities to capture and benefit from external sources of knowledge to enhance current technological developments (van de Vrande et al., 2009). In a fully open setting, firms combine both technology exploitation and technology exploration in order to create maximum value from their technological capabilities or other competencies (Chesbrough and Crowther, 2006; Lichtenthaler, 2008). Initially, in open innovation research this was studied within firms (inter-firm) or between firms (intra-firm), whereas later open innovation studies from a user innovation perspective examine how firms can collaborate with users in order to facilitate a process of external exploration as well (West and Lakhani, 2008). However, both processes have different hypothesized spillovers: within open innovation research, these knowledge and technology spillovers are situated amongst firms in an exchange or pecuniary modus, whereas in user innovation research, these spillovers from users to producers are not pecuniary in nature (Bogers and West, 2012). Besides these main processes of exploitation and exploration, **knowledge retention** has also been put forward as an important process in the context of open innovation, indicating the storage, maintenance and reuse of knowledge over time (Lichtenthaler and Lichtenthaler, 2009).

However, recently the open innovation approach has also been criticized. Trott and Hartmann (2009), for example, disagree with the open versus closed innovation dichotomy, since most companies are somewhere in between. 'Open' versus 'closed' is too simplistic and fails to adequately describe and analyze recent innovation strategies. Indeed, the collaboration between companies is often only ad hoc or project based and not all the relevant stakeholders are always involved in the innovation process (Bogers, 2011). On top of that, organizations and collaborations can differ in their degree of openness as well. When practicing open innovation, there is a difficult balance between sharing knowledge and protecting knowledge, something which is referred to as the 'information paradox' (West et al., 2005; Bogers, 2011). Ortt and van der Duin (2008) also acknowledged this issue and put forward that in

nowadays turbulent innovation environment, no single innovation management best practice exists anymore. Instead, they plead for so-called 'contextual innovation', or the fact that innovation management should be tailored towards the organizational and societal context of the innovating company. This is confirmed by Torkkeli et al. (2009) who found that the incentives to engage in open innovation are different for large versus small companies, while Mention (2011) discovered that a higher degree of innovation novelty shows a positive relation on the degree of co-operation and usage of external knowledge sources.

This overview stresses the importance of external networking, including all activities to acquire and maintain connections with external sources of social capital, including individuals and organizations (Chesbrough et al., 2006). As such, this comprises both formal collaborative projects and more general and informal networking activities. Open innovation networks, which can range from informal links to formal R&D alliances, allow firms to rapidly fill in specific knowledge needs without having to spend enormous amounts of time and money to develop that knowledge internally or acquire it through vertical integration (van der Vrande et al., 2009). In the light of the three open innovation processes, open innovation networks demand for three corresponding firm capabilities: *absorptive capacity*, or the ability to deal with knowledge exploration, *connective capacity*, or the ability to deal with knowledge retention, and *desorptive capacity*, or the ability to deal with knowledge exploitation (Lichtenthaler, 2011).

Within this paper, we will examine open innovation processes from a network-perspective, steering away from the strong firm-centric perspective which dominates a lot of open innovation research. We will not take into account the specific internal capabilities of firms, but instead focus on the nature, direction and motives for the knowledge and technology flows between the different actors involved in a Living Lab. This is also in line with the evolution from the Living Labs-concept from user-centered towards a more full blown ecosystem approach.

4 Methodology & hypotheses

In the next sections, we will validate this conceptual model of a Living Lab and investigate how value is created for each of the actors, how knowledge is being shared and how common goals can be achieved through the Living Lab innovation network by exchanging knowledge and enabling technology flows between these actors. For this analysis we take an open innovation perspective to study the phenomenon of Living Labs as innovation systems, divergent from any of the previous studies on Living Labs. We will do this by means of an in-depth case study of the LeYLab Living Lab and the various cases that have ran within this Living Lab over a time span of two years, the formal duration of the Living Lab. Case study research excels at bringing 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 are especially suited for investigating new and poorly understood processes, with their emphasis on detailed contextual analysis of a limited number of events or conditions and their relationships (Eisenhardt, 1989). Yin (1984) 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, the multiple levels of analysis (actors, knowledge flows, etc.) and the participation of the author team in the Living Lab itself, this research design seems most appropriate.

For our analysis we were able to use the following data sources as first-hand involved actors in the Living Lab operations and Living Lab cases:

- official meeting minutes of all steering committees and of all official work package meetings
- the initial project proposal and all project reports
- all deliverables from the Living Lab operations and of the Living Lab cases
- all data from user research regarding Living Lab operations (intake surveys, domestication interviews,...) and regarding the Living Lab cases
- field notes of all Living Lab cases meetings

- data from a short survey that was held amongst all actors participating in the Living Lab at the end of the Living Lab, which took more or less the form of a SWOT-exercise

Based on our conceptual model and our literature review on open innovation and knowledge flows, we hypothesize that the motivations and the (potential) associated value for the different actors participating in the Living Lab are related to the specific roles they take in the Living Lab-constellation.

	Motivations to participate in the Living Lab	**Value created by the Living Lab**
Utilizers	Develop, test and learn Exploration for innovation	Need information Solution information
Enablers	Meet policy goals	Stimulating economic and social value creation
Providers	Exploitation of provided infrastructure	Market strategy Showcase infrastructure
Users	Intrinsic motivations over extrinsic motivations	Fun Participation/empowerment
Researchers	Exploiting implementable knowledge Exploring new knowledge	Research data for academic valorization

Table 1. Hypothesized motivation according to role in Living Lab

For **utilizers,** we expect exploration as main motive in order to stimulate their innovation processes. The Living Lab provides the opportunity to get need information and solution information from the users involved in the Living Lab. For them, it is an ecosystem in which they can develop, test and learn. The **researchers** are expected to function as intermediaries between utilizers and users, as through their research they are able to abstract need and/or solution information from the users, which the utilizers are looking to explore. However, the Living Lab operations and activities also allow researchers to explore their own knowledge base (testing hypotheses, generating new theories/ methodologies, etc.). They expect to generate research data that can be academically valorized. By doing so, researchers contribute to the knowledge retention of the Living Lab. For **providers**, we expect exploitation of the technology and/or knowledge they bring into the Living Lab network as main motive. They expect the Living Lab operations to provide them with input for their market strategy and roadmap. On top of that, the Living Lab enables them to showcase their innovative infrastructure. For **users**, we expect intrinsic motivations (such as task enjoyment and curiosity) to participate in the Living Lab to be dominant, as knowledge transfers between users and producers have found to be non-pecuniary. However, extrinsic motivations might also play a role (incentives and social value). As **enablers** contribute to the Living Lab with money or others assets that enable the Living Lab operations, these public organizations expect the Living Lab to fulfill some predefined policy goals. Mostly, this concerns the generation of social and/or economic value, such as increased neighborhood cohesion or stimulating innovation and entrepreneurship. In the proposed conceptual model of a Living Lab, **infrastructure** has a central role since it facilitates collaboration among all actors and enables knowledge and technology spill-overs within the innovation ecosystem.

Besides these role-specific hypotheses, we also expect that actors engage in Living Labs because a too broad search for the relevant exploration or exploitation knowledge is inefficient, which draws them to collaborate with a smaller set of actors (Torkkeli et al., 2009). As the absorptive capacity of an actor is related to the degree of previous experience and trust with the other partners, we expect this to have an influence on the Living Lab operations (Bogers, 2011). Based on Mention's (2011) finding regarding co-operation and knowledge sources practices being associated to higher degrees of innovation

novelty, we expect innovations being tested and created during Living Lab operations and cases to score high in terms of novelty. Finally, based on the observation that there exist asymmetric incentives for large and small firms in the case of open innovation (Torkelli et al., 2009), we expect company size to have an effect as well.

5 Results & discussion

LeYLab was a Living Lab situated in Flanders, Belgium which offered fiber internet access to a panel of households and organizations. This Living Lab was set up in September 2010 following the public call in Flanders for Living Labs with 'Converged Broadband Access networks' as a central theme and was subsidized by IWT, the Flemish public investment organization for innovation and science. The Living Lab was operational by July 2011 and its fiber network was located in two geographically 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 fiber, testing innovative applications and services was made possible, meanwhile enabling and strengthening a user community and a collaborative ecosystem. Fiber offered unprecedented test facilities, in terms of bandwidth and quality of service and stimulates the ICT sector to develop innovative applications. Therefore, the shared goal of LeYLab was to stimulate innovation and to measure the relevance of new services for the personal lifestyle and living environment of the test users. Two main topics were chosen as focus for the Living Lab: innovative media and eHealth.

In order to set-up the Living Lab innovation network, a large consortium was composed of eight private partners, three public organizations and one public authority.

Alcatel-Lucent (www.alcatel-lucent.be), a multi-national technology company, took the project lead, provided the necessary equipment for the in-home usage of the fiber connection (modem, router,…) and was responsible for the monitoring of the network (logging) and for the integration of all services and devices within the network. **Belgacom** (www.belgacom.be), the largest telecom provider in Belgium, deployed the fiber infrastructure and supervised the network. This was facilitated by the **City of Kortrijk** (www.kortrijk.be) who enabled the permits needed to install the network, started the

communication loop with the potential test users and engaged local stakeholders for the Living Lab initiative. All research activity, panel recruitment and panel communication was executed by the **iMinds** (www.iminds.be) research institute. These four parties were active in both thematic domains and can be considered as responsible for the general Living Lab operations. Regarding the deployment of the network, a necessary precondition for all Living Lab operations and eventual Living Lab cases, this took much more time than expected. Time and effort for convincing people to participate and for effectively putting the fiber in the ground and installing the necessary devices in the homes of the users were underestimated by the consortium partners.

	Actor	**Role**
Utilizers	Two internal cases + external utilizers	Run applications and services on infrastructure
Enablers	City of Kortrijk	Facilitation and communication
Providers	Alcatel-Lucent Belgacom	Infrastructure deployment
Users	LeYLab panel members	Testers
Researchers	iMinds	User experience research Panel profiling

Table 2. Core Living Lab actors for LeYLab

The other actors from the consortium could be allocated to one of the thematic domains, as they were involved in one of the two thematic use-cases that were predefined before the Living Lab was set-up. The first use-case consisted of the roll-out of an audiovisual content archiving and distribution system for local content. **Zeticon** (SME, a small university spin-off with a media asset management system, www.zeticon.com), **Videohouse** (SME, medium-sized AV technology provider, medium-sized company, www.videohouse.be) and **Focus WTV** (SME, medium-sized regional broadcaster, SME, www.focus-wtv.tv) were gathered to set-up an innovative media database allowing to share and archive multi-media content over the fiber network.

	Actor	Role
Utilizers	Zeticon Videohouse	Develop and evaluate AV-content archiving and distribution system
Enablers	City of Kortrijk	Promote and distribute local content
Providers	Focus WTV	Content provider
Users	LeYLab panel members Other citizens	Sharing own content and consulting content archive
Researchers	iMinds	Research user experience

Table 3. Living Lab actors for the audiovisual pillar of LeYLab

The second use-case, within the eHealth thematic domain, dealt with a solution for remote video communication for elderly and disabled people that could be used on a regular TV-set. The following consortium partners were involved: **Androme** (SME, medium-sized ICT support, www.androme.com) provided specific technological knowhow on operating and integrating networked ICT solutions, **In-Ham** (small public sector organization concerning eHealth, www.inham.be) added their specific expertise on dealing with elderly and disabled people, **U-Sentric** (SME, medium-sized university spin-off specialized in usability testing, www.usentric.be) was part of the consortium because of their expertise in usability testing of eHealth technologies, **OCMW Kortrijk** (public health organization from the city of Kortrijk) added knowhow of the local population and health ecosystem, and **Televic Healthcare** (eHealth technology company, www.televic-healthcare.com) provided their XTramira solution which enables remote communication with a set-top-box connected to a TV-set.

These use-cases were also meant to provide the first FTTH and Living Lab applications to the test users, so they could start testing, and as showcases to attract external utilizers to the Living Lab.

However, besides the slow deployment of the Living Lab infrastructure, both use-cases also suffered from various other difficulties. These resulted in the media case being up and running only during the final month of the Living Lab and the eHealth use-case not being implemented at all because of difficulties integrating the solution on the fiber infrastructure and because of the lack of panel members who needed healthcare.

	Actor	**Role**
Utilizers	Televic Healthcare	Evaluate remote video chatting application
Enablers	OCMW Kortrijk	Enable roll-out amongst target population
Providers	Androme In-Ham	Integrate solution in the network Facilitate roll-out
Users	Elderly & disabled LeYLab panel members	Test remote video chatting application
Researchers	iMinds U-Sentric	Research user experience Research usability

Table 4. Living Lab actors for the eHealth pillar of LeYLab

The aforementioned issues regarding the general Living Lab operations also affected the generation of **external Living Lab cases** as the lack of cases and research material made it hard to convince external utilizers to come to the Living Lab. Eventually, three external Living Lab cases ran in the Living Lab: *Poppidups* (a virtual puppetry application playable online with cards containing a unique QR-code,

created by the SME Prophets, specialized in online marketing), *Cloudfriends* (a network optimization application that also included Wi-Fi configuration based on user feedback developed by SME and start-up company Cloudfriends) and *WeePeeTV* (an over-the-top streaming TV application developed by SME WeePee New Media Ventures). In all three cases users were involved in testing, evaluating and co-creation of the innovative applications.

The next section reviews our main hypothesis based on the actual Living Lab experiences of the different actors.

The external **utilizers** were able to explore, test and develop their innovations based on user feedback and user behavior captured by the researchers, who abstracted user needs from the data through co-creation sessions, observations and surveys. In the case of Cloudfriends, the Living Lab case led to an expressed user need that made the utilizer redesign its application, something which resulted in exploiting the technology to a foreign multi-national. When going through the notes from the intake meeting, it became apparent that this utilizer already thought of exploiting its technology, possibly to one of the providers of the Living Lab. Other utilizers focused on exploration instead of exploitation. All external utilizers were able to utilize the knowledge from the Living Lab case for the innovation development, but in two of the three instances, extra test users had to be recruited outside of the Living Lab, and only one of the innovations explicitly benefitted from the technical infrastructure (WeePeeTV).

The **researchers** did function as intermediaries between utilizers and users, but had to define other research activities because of the lack of internal and external cases in order to activate the panel members. The aggregation of research activities provided enough data and material for academic valorization. As discussed in the next paragraph, collaboration with the providers of the Living Lab also resulted in mutual benefits due to the exchange of knowledge. While academic valorization of research data gathered within the Living Lab enhanced the desorptive capacity of this actor, the enabling role towards utilizers and providers defines the research actor as an innovation broker with connective capacity.

The **providers** of the main Living Lab infrastructure, Alcatel-Lucent and Belgacom, were able to exploit their technologies (the physical fiber network and the related devices such as the modems) as they were able to demonstrate their added value, thus also increasing their desorptive capacity. Although, the Living Lab did not generate 'the' killer application that would make fiber internet a necessity, research data from surveys showed that the users were nonetheless excited with the sheer speed of the network and technical logging data indicated that they started using more bandwidth when they had 'domesticated' their fiber installation (Schuurman et al., 2013b). This logging data enabled an additional exploration of user behavior, which could be used for future developments. This logging data was exchanged and confronted with other research data from the researchers, which provided additional value for the providers, who complemented their logging data with self-reporting data, and for the researchers, who could verify the self-reported data with objective log files. For the providers within the thematic use-cases, the motives were mixed. Androme mainly wanted to explore its knowledge regarding integration of ICT solutions and InHam wanted to further establish itself as sector organization for eHealth, whereas Focus WTV looked at the use-case as a potential new source for exploiting its content. In terms of motives, these appeared to have both an exploring and exploiting nature, increasing absorptive and desorptive capacities of the organizations.

Surveys indicated that **users** mainly participated because of the infrastructure (extrinsic motivation) and out of curiosity (intrinsic motivation), so the infrastructure itself was considered an incentive. An unforeseen effect of the Living Lab activities was a strong sense of community among the test users. The geographic proximity, the collaborative interactions and the shared infrastructure seemed to increase social cohesion, which became apparent during offline gatherings where the participation of panel members was very high and by spontaneous actions such as helping each other in case of technical problems. The strong infrastructural component of the Living Lab appeared to be a very important aspect for the users and had a positive influence on the willingness to participate in research activities.

The city of Kortrijk as **enabler** was able to establish itself as an innovative city towards its citizens and towards other cities and stakeholders. This resulted in the inclusion in a large European smart city-

project during the running time of the Living Lab and also in LeYLab becoming an official member of ENoLL. The community project based on the internal media case could not be executed because of the late realization, but this was compensated by the spontaneous community building effect of the Living Lab. The Living Lab both increased social value (increased social cohesion) and supported SMEs in the development of innovations (economic value).

The FTTH as a central innovative **infrastructure**, had a double role in this Living Lab. On the one hand, the roll out en set-up of the hardware delayed the actual kick-off of the Living Lab project. On the other hand, due to the close collaboration which was needed to achieve the operational goals, this also stimulated the core partners to establish an open relationship and increased the level of trust between the infrastructure partners.

From the general hypotheses, the tendency towards collaboration with a smaller set of partners because of efficiency reasons could be confirmed. On paper twelve partners were involved in the LeYLab-consortium, but in reality, the main operations and activities were carried out by only four partners that exchanged a lot of knowledge. This was related to the strong emphasis on the infrastructure of the Living Lab which required a coordinated effort of these partners. The other consortium partners had different goals and interests, mainly related to the two thematical use-cases, without specific interest in the infrastructure itself. As Belgacom and Alcatel-Lucent both had an interest in exploiting their fiber-related technologies and devices, they were actively looking for 'proof' that there was a user interest in fiber internet and that external companies would succeed in finding a 'killer app' that required fiber. Therefore, they were also most active in the exploitation of the Living Lab infrastructure itself, i.e. attracting external utilizers. The researchers from iMinds also benefitted from the activity within the Living Lab as this generated data, potential for knowledge exploitation. Kortrijk as enabler wanted to profile itself as a 'smart' and innovative city, which also made them very active throughout the total time frame of the Living Lab. Common elements between these core Living Lab actors are (1) common of compatible long-term goals, (2) a higher availability of resources, related to the size of the organization, (3) the close interaction for the roll-out of the technical infrastructure and (4) none of them were utilizers only.

Trust was an important element especially for the external recruitment of utilizers. The presence of one of the providers from the eHealth-case appeared to refrain certain external utilizers to come to the Living Lab as they feared that their ideas would be picked up by this firm. This became apparent during the business development activities undertaken to attract external utilizers. Three companies, which we cannot mention because of reasons of confidentiality, were initially interested in testing and co-creating their innovations in LeYLab, but eventually decided not to participate because of the presence of Televic Healthcare. In one of these three cases, the potential utilizer decided to engage in bilateral contract research with one of the research parties instead. This clearly illustrates the limitations to the degree of openness in the development of innovations.

For the Cloudfriends case, the presence of a competitor was on the contrary an incentive to engage in the Living Lab, but only because this external utilizer was already aiming at possibly exploiting its technology from the start.

The expectation that the Living Lab attracts innovation with a high degree of novelty could be confirmed as well. WeePeeTV was the first over-the-top streaming TV service available in Flanders, the easy home Wi-Fi access and the auto-correcting functionalities of the Cloudfriends-app were also new to the Flemish market and the concept of a virtual puppetry theatre was also the first of its kind. The two internal use-cases were less novel in terms of functionality, but wanted to innovate in terms of ease-of-use for the target population. Mixed evidence could be found for the hypothesis regarding company size. In general, the large companies had more motives related to exploitation and acted as providers, whereas the SMEs were more likely to be utilizers of the Living Lab and looked to explore their knowledge base in order to add to further develop and fine-tune their innovations. However, there are also examples that show the exact opposite. In the Cloudfriends case the start-up company was looking to further explore its technology, but in the meantime kept in mind to potentially sell their technology to one of the providers, and by entering the Living Lab they were able to exploit and sell their technology, albeit to an external company. Televic is an example of a larger company wanting to exploit its technology in the role of utilizer, something which turned out to be unsuccessful.

6 Conclusions

Companies still struggle to adequately manage their innovation processes in order to create successful and innovative products and services. Different literature streams such as the user innovation and open innovation frameworks have pointed out the importance of reaching out of the firm boundaries and collaborating with other stakeholders, but no single 'best practice' approach has been defined yet. Living Labs have been put forward by the European Commission as a potential instrument to overcome the apparent 'European paradox' between exploration and exploitation. The European Network of Living Labs has been founded as an organization to help spread en develop this approach. However, we have seen a declining growth and a lot of 'dead' or inactive initiatives, which stresses the need for further conceptualization. Therefore, we have proposed Living Labs as open innovation systems where different ideas and concepts can be explored and validated with different actors, facilitating the exchange of knowledge and technologies. This paper proposes and illustrates a conceptual framework that analyses the different actors within a Living Lab ecosystem. Clustered around a central infrastructure, five types of actors are identified and analyzed. The different roles that are assigned to the different actors are associated to certain open innovation activities, but during the Living Lab-operations, some actors may switch or combine roles.

The three external utilizers of LeYLab and five of the twelve consortium partners were Flemish SMEs. This indicates that the studied Living Lab clearly succeeded in attracting SMEs to engage in open innovation, a group that was lagging behind (van de Vrande et al., 2009). The role of utilizer seems to be most fitting to them as this allows them to benefit from the Living Lab-infrastructure in order to explore their technology, with the potential to be noticed by a partner inside or outside the Living Lab which offers exploitation possibilities. Because of an absence of common goals, scarce resources and the short-term nature of this actor, full consortium membership is not needed or hard to maintain. The role of provider of the Living Lab infrastructure, on the other hand, seems to be best suited for larger companies with more established and stable technologies, as the smaller providers from the case study failed to deliver or engage themselves in the Living Lab. Besides exploitation of their infrastructure,

Living Labs also facilitate the exploration of new ideas and technologies through the multiple (external) Living Lab cases that take place in the Living Lab.

The researchers in the Living Lab have an important mediating role between the utilizers and the users, as they make information regarding user needs 'unsticky' (von Hippel, 2005) by means of specific research methodologies. The enablers of the Living Lab play an essential role in supporting and facilitating the Living Lab. Therefore, Living Lab activities should be tailored towards the policy objectives of the enablers. A city appeared to be quite suited for this role as they have a direct link to the citizens (potential test users), local private companies (potential utilizers) and local organizations (potential providers). The local aspect of the 'city Living Lab' also fostered a strong sense of community building among the test users, something which is less likely to occur in a geographically dispersed Living Lab.

The thematic focus of the Living Lab and the number of partners are of utmost importance in order to be able to align the goals of the different partners, something which did not fit well in the case study, but which was solved in a natural way through the actual degree of collaboration between the parties who did share common goals. In LeYLab, this was the case for the four partners responsible for the actual set-up and roll-out of the infrastructure. This required an orchestrated effort and in order to get insights into the actual usage and behavior of test-users, testing of external applications and services was required.

Another important lesson is that the definition of internal use cases is of utmost importance in order to '**headstart**' **the Living Lab with cases** that activate the users and generate research data and showcases to attract external utilizers. In LeYLab, two internal use-cases were planned, but these took too much time or suffered from too many set-backs to actually get the Living Lab up and running. This resulted in only three external cases being carried out in the Living Lab which started only towards the formal end of the Living Lab. Early Living Lab activity is important to confirm the consortium, engage the user community and to attract external utilizers.

The main limitation of this paper is that it draws upon the experiences of one Living Lab. Therefore, it is difficult to generalize the insights. However, the networked and systemic nature of Living Labs and innovation processes running in these Living Labs lend themselves towards a case study research approach, and this paper is the first to analyze these processes, set-up, roles and outcomes taking an open innovation perspective. Future research might reassess the given hypotheses in a different Living Lab setting or focus on fewer relations or actors and assess them on a larger scale, also taking into account the outcomes of innovation processes and cases occurring in Living Labs. Furthermore, it might be interesting to validate these findings in other domains, with other infrastructures and non-geographically centralized Living Lab initiatives. Finally, further academic elaboration is needed on the difference between actors and roles, with a special focus on the combination of roles within a Living Lab project.

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